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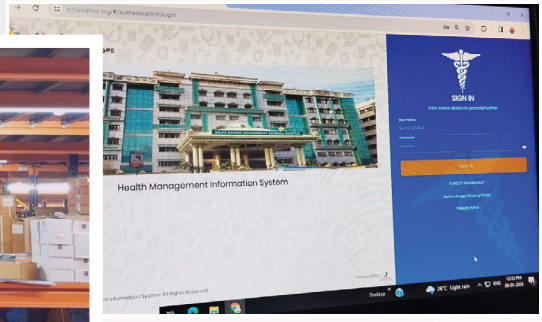
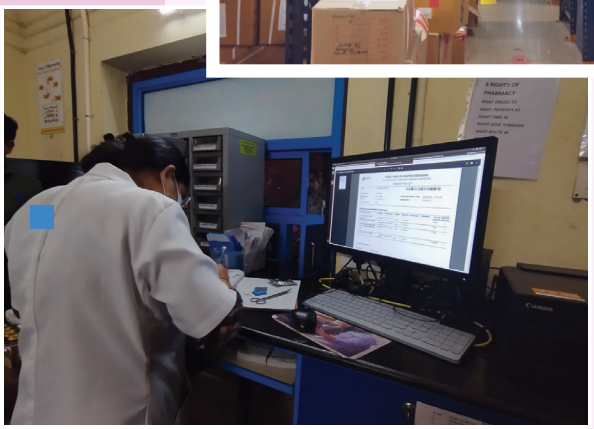
परिवार कल्याण मंत्रालय
MINISTRY OF
HEALTH AND
FAMILY WELFARE

सत्यमेव जयते

NATIONAL HEALTH MISSION
राष्ट्रीय स्वास्थ्य मिशन

ASSESSMENT OF
IT-ENABLED SUPPLY CHAIN MANAGEMENT OF MEDICINES
IN PUBLIC HEALTHCARE INSTITUTIONS UNDER NHM

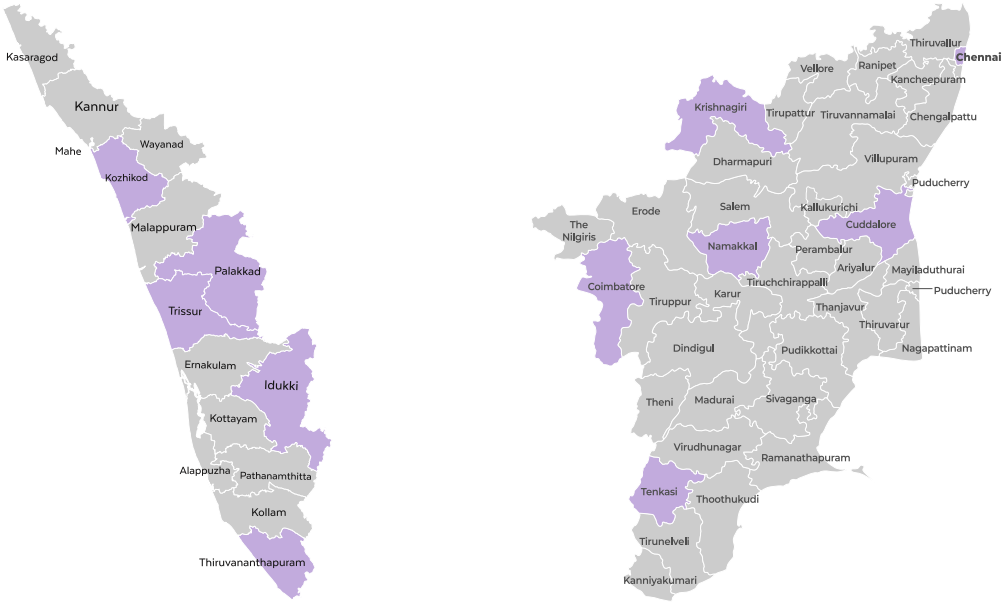




2025

Assessment of IT-enabled Supply Chain Management of Medicines in Public Healthcare Institutions Under NHM

A Cross-Sectional Study on Tamil Nadu and Kerala



2025

Knowledge Management Division

National Health Systems Resource Centre (NHSRC)

Ministry of Health and Family Welfare

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EXECUTIVE SUMMARY

INTRODUCTION

Supply Chain Management (SCM) in healthcare systems holds significant social relevance, as its reliability and stability directly impact public health. A robust SCM empowers providers to deliver health services efficiently and responsively, leading to measurable and positive outcomes. While striving for efficiency and responsiveness, health sector supply chain initiatives often prioritize cost reduction and enhanced process adaptability. However, this focus can inadvertently lead to under-investments in other crucial drivers of supply chain efficiency, such as sector-wide digitalization and logistics management.

Digitalization efforts in SCM encompass the use of various traditional and advanced technologies to connect stakeholders, synchronize information and material flows, optimize time, and enhance supply chain flexibility and agility. Although some studies suggest the positive effects of digitalization on supply chains, an in-depth evaluation of its role in SCM processes and performance within the health sector is still needed. This need is particularly acute in the public health systems of developing economies like India, given the prevalence of diverse health system resource optimization approaches.

In India, the Ministry of Health and Family Welfare (MoHFW) has been supplementing State-specific efforts to improve access to free, affordable, and quality healthcare. Under the National Health Mission (NHM), concerted efforts have focused on enhancing access to medicines and diagnostic services in public healthcare facilities through dedicated programs like the Free Drugs and Diagnostic Services Initiatives. With an increasing emphasis on sector-wide digitalization, the Ministry of Health and Family Welfare, Government of India, mandated NHSRC to understand and document the role of digitalization in SCM processes, management, and performance within the Indian Public Health System in Tamil Nadu and Kerala. The States were selected due to their early adoption of IT-enabled SCM systems, centralized procurement models, and strong performance noted in national common review missions. This study evaluates their models, identifies strengths and limitations, and recommends strategies for strengthening SCM at both national and state levels within the public health system.

SCOPE OF THE STUDY

This assessment focused on:

- **States:** Tamil Nadu and Kerala.
- **Entities:** Tamil Nadu Medical Service Corporation (TNMSC), Kerala Medical Service Corporation Limited (KMSCL), District Drug Warehouses (DDWs), Primary and Secondary level public healthcare facilities.

- **Medicines:** Essential medicines only (tracer-based assessment using 13 medicines).
- **Processes Assessed:** Forecasting, procurement, distribution and logistics, inventory and stock management, and the role of ICT platforms in these key processes.
- **Cross-cutting Areas:** Governance, infrastructure (hardware/software), human resources, and financing mechanisms.

OBJECTIVES

Primary

- To understand the IT-enabled Supply Chain Management model for medicines adapted by the States of Tamil Nadu and Kerala
- To understand the State-specific models' performance in specific SCM activities

Secondary

- To assess the availability of medicines in healthcare institutions under NHM

METHODOLOGY

The study used a cross-sectional, mixed-methods design, covering 101 health facilities (51 in Tamil Nadu, 50 in Kerala) using cluster sampling. Data was collected through in-depth interviews, facility audits, manual and digital stock records, and through end-users exit interviews. Quantitative data were processed using Excel and STATA. Qualitative data from providers and policymakers were analysed thematically. Data collection spanned from Nov 2023 – Feb 2024 in Tamil Nadu and Apr – Oct 2024 in Kerala.

STATE CONTEXTS: TAMIL NADU AND KERALA

Tamil Nadu and Kerala have distinct yet structured healthcare systems under their respective Departments of Health and Family Welfare. Tamil Nadu's public healthcare facilities are managed through three directorates—DPH, DMS, and DME—while Kerala has two primary directorates, DHS and DME, with significant contributions from Local Self Government Departments (LSGD).

Both States have established dedicated medical service corporations—Tamil Nadu Medical Service Corporation (TNMSC) and Kerala Medical Service Corporation (KMSCL)—to streamline drug procurement, distribution, and logistics management. The Drugs Distribution Management System (DDMS) drives key SCM processes and plays a pivotal role in ensuring transparency and efficiency in supply chain activities of both States.

Additionally, Kerala has advanced digital health integration through the e-Health Project under the State Digital Health Mission, which consolidates electronic medical records (EMRs) and health databases, supporting healthcare accessibility and

surveillance. While Tamil Nadu has influenced Kerala's supply chain management model, Kerala's structural and operational nuances make its healthcare system uniquely adaptive and integrated across social development sectors.

KEY FINDINGS AND OBSERVATIONS

General Findings

State-specific SCM Model: The strength of a State's supply chain model is positively associated with the gains of its overall health system strengthening efforts. Given the health-sector-wide thrust on digitalization of SCM practices, the findings emphasize that clearly defining the need and expected outcomes when introducing ICT platforms into existing SCM models is crucial. Successful State experiences with the universal adoption of digital systems, guided by high-level decisions to automate SCM processes, such as in Kerala, should be leveraged as exemplars. Furthermore, the positive sentiment and demonstrated workflow enhancements associated with such systems are expected to foster broader acceptance of digital platforms compliant with the Ayushman Bharat Digital Mission (ABDM).

Conversely, models that are predominantly manual at health facility levels yet IT-driven at central procurement levels, such as in Tamil Nadu, highlight the need for a definitive blueprint for integration. The absence of such integration leads to limited utility, a lack of operational linkages, dual record-keeping, and additional workload.

Infrastructure: Adequate infrastructural investments (both physical and digital) are essential across States for strengthening interoperability, optimizing space management, and facilitating the digital adoption of IT-enabled supply chain systems. Both States studied possessed infrastructure commensurate with their specific SCM models, enabling them to maintain supply chain efficiency.

Human Resources for Supply Chain Management: Human resources emerged as one of the most pertinent drivers of supply chain efficiency in both States. The overall HRH availability ratio[1] was strong in both the States, with Kerala (1.26) showing a stronger ratio compared to Tamil Nadu (0.87). It was observed that gaps were mostly present at the level of secondary care facilities, as reflected by relatively higher turnover and vacancy rates compared to primary level facilities. The regular cadre in both States functioned with defined roles and were assigned exclusive responsibilities for SCM, while delegating complementary functions to contractually hired HRH such pharmacy operations. The regular pharmacists were alone given access to DDMS in both States. In Kerala, e-Health access was available for both regular and contractual pharmacists. Additionally, the ability to retain the existing regular cadre was found to significantly support the streamlining of SCM activities in both states. In Tamil Nadu, the shortfall of regular HRH was a major concern across the districts. In Kerala's context, there was no shortfall in the overall HRH availability yet it was insufficient for meeting operational requirements for equitable work distribution.

1. Total HRH for SCM available against sanctioned

Governance: A robust SCM governance structure is essential for managing the wide range of activities and stakeholders involved in the SCM of medicines. Both States integrated quality control and assurance mechanisms within the broader SCM governance framework, with Tamil Nadu opting for centralized procurement controls and Kerala adopting a decentralized oversight via broader health governance mechanisms, which includes institutional, district and state level functionaries under DHS and local self-government department. Furthermore, the integration of ICT platforms was found to aid transparency in operations and enforce accountability among internal and external stakeholders of the SCM system in both States.

However, gaps in communication between internal stakeholders were noted in Tamil Nadu, while a lack of formalized protocols and timely condemnation procedures were observed in Kerala. Inconsistencies in prescription practices due to various factors observably affected supply chain efficiency and quality of care delivered to the end-users in both States. Some of the factors observed in both States include non-availability of prescription chits or dispensing covers/envelopes, prescription of branded medicines and outside the Essential Drug List, lack of coordination between the physicians and the pharmacists to align prescription with availability at the facility, or non-adherence to standard therapeutic regimen to rationalize medicines as per availability.

Forecast: In a resource-constrained, IT-enabled SCM system, strengthening digital tools to enhance forecast accuracy, improving documentation at the facility level, and aligning financial allocations with demand remain key areas for optimization. TNMSC finalizes the Essential Medicine List annually through the Drug Committee, who scrutinizes and modifies the proposed items in terms of their demand, relevance, and movement in the facilities. Further, the committee consults with the Director of Drug Control to finalize the specification of each item to the pharmacopeia standards. The quantity forecasted for tenders is based on the analytical insights of the previous year's purchase and utilization provided by the DDMS portal at TNMSC. Meanwhile in Kerala, KMSCL gathers details of items to be procured under NHM projects and prepares a tentative medicine list that is scrutinized against pharmacopeia standards. To support this process, KMSCL conducts divisional workshops to discuss procurement procedures and indenting guidelines for the next FY. HCFs are then invited to suggest revisions to the medicine list. Following this collaborative exercise, KMSCL convenes a sub-committee meeting to finalize the medicine list, define financial caps, allocate medicines under different heads.

However, it was not possible to ascertain the alignment between forecasted demand, actual indent, and actual consumption across the supply chain of both states. In Tamil Nadu, the data for estimated consumption/requirement at the HCFs was not documented, which meant the rigor of forecasts done at the HCFs could not be appraised. Meanwhile, in Kerala, there was a widespread supply-side reliance on indent data rather than forecast data. Considering that indent estimates are influenced by budgetary constraints, lead times, perceived risks of stockouts or overstocking, and human error, it was difficult to directly infer or compare forecast accuracy over time or across different locations in Kerala.

Procurement: Reinforcing forecasting tools, optimizing procurement timelines, and enhancing transparency in local purchases are essential for improving procurement efficiency. Both States have robust procurement models, with Tamil Nadu emphasizing volume-based purchasing for supply stability, while Kerala integrates government-owned not-for-profit enterprises for supplementary procurement in addition to centralized mechanisms. The practice of global tendering[2] and the creation of a diverse supplier pool in Tamil Nadu serve as critical safeguards for the public health system against external supply chain shocks. Inter-state coordination between TNMSC and KMSCL for emergency procurement during crises is a notable practice followed by both States.

Distribution and Logistics Management: Both States have successfully implemented equitable distribution mechanisms across levels of care that consider geographical distance, facility consumption rates, the priority of essential/life-saving molecules, and available procurement options at the facilities. However, logistics management requires significant attention at scale due to existing gaps and challenges in transport arrangements. Notwithstanding the constraints in logistics management, robust governance mechanisms implemented in both States were observed to foster collaboration among healthcare facilities, warehouses, district-level functionaries, or local self-government departments, who played crucial roles in facilitating timely distribution, optimizing costs, and containing supply lead times.

Inventory and Stock Management: Strengthening real-time data capture, improving condemnation processes, and enhancing storage infrastructure are pertinent for robust inventory and stock management in health facilities. States' adequate investments in drug warehouses are observed to significantly contribute to efficient inventory management and waste mitigation. Both States demonstrated satisfactory inventory and stock management, especially attributable to the provisions for inter-warehouse and inter-facility transfers for optimizing stock movement across districts and HCFs.

Stock Availability: Real-time stock tracking, optimizing procurement cycles, and improving facility-level documentation are crucial for improving stock availability at facilities nationwide. Secondary level facilities (SDH/DH/GH) were found to have less stock out rates in both States, as compared to primary level facilities (AAM -PHC). While overall stock availability was satisfactory in both States, higher stockout rates linked to procurement cycles tied to the financial year, as observed in Kerala, hinder demand fulfilment in the transition period of the Fiscal years (January to April).

2. Global tendering refers to a procurement process where the organization invites bids from suppliers or contractors worldwide for the supply of goods and services.

State-Specific Findings

Indicator	Tamil Nadu	Kerala
Infrastructure		
Dedicated storage spaces	Generally adequate in both primary and secondary level facilities.	Mostly adequate in secondary level facilities. Spatial constraints widely observed in primary level facilities. Modular pull-out storage bins and organizer racks enhance storage efficiency.
Availability of IT equipment	Provided by government; shared in primary level facilities	Government-funded (KMSCL/LSGD and e-Health)
Internet connectivity	Instability, high latency issues	Widely made available through BharatNet. Generally stable across facilities
SCM digital integration	DDMS for stock management, limited interoperability with TNMSC's DDMS. TN's HMIS was differentially implemented.	Universal adoption of DDMS. Implementation of e-Health platform was ongoing.
Temperature-monitoring equipment	Present but varied by facility level	Standardized across facilities
Data management approach	Dual record-keeping (manual & digital)	Digital-first approach via DDMS, supplemented by pharmacy module of e-Health. Manual tracking of costly/habit-forming medicines.

Indicator	Tamil Nadu	Kerala
Human Resources for Supply Chain Management		
Total HRH availability ratio (R+C)	Strong overall availability ratio (0.87)	Stronger overall availability ratio (1.26) due to responsive contractual placement by LSGD and HMC. Gross availability exceeds IPHS requirements.
Turnover rate	Highest in DHs and CHCs	Highest in CHCs and Block FHCs
Vacancy rate	Significant gaps in DHs and SDHs	Some vacancies in THs and CHCs
Recruitment against vacancies	<50%, reportedly due to a law suit against recruitment of regular pharmacists	<50% yet facility-wise recruitment was commensurate to needs
Training for pharmacists	Provided, but not comprehensive, affecting digital adoption	Structured onboarding & digital training. Training supported by SIHFW, SHSRC, and Kerala's LMS.
Task-shifting mechanisms	Managed by deputed staff or staff nurse at primary facilities, and through task-sharing at secondary facilities.	Managed by deputed staff at primary facilities, and through task-sharing at secondary facilities.
Governance		
SCM oversight structure	Centralized through TNMSC up to DDWs	Decentralized under KMSCL, DHS, and LSGDs. Availability of clearly defined roles, responsibilities, and liabilities.
Healthcare facility governance	Limited TNMSC mandate beyond DDWs. Facility oversight exclusively by the Directorates.	Integrated oversight under DHS and LSGDs

Indicator	Tamil Nadu	Kerala
Review mechanisms	Monthly district-level review meetings	Weekly/Monthly virtual monitoring, quarterly reviews are being held by KMSCL, State level and district level functionaries
Communication efficiency	Generally satisfactory. Instances of misinterpretation of State issued advisory at HCF level noted across districts.	Generally satisfactory with extensive digital coordination, but there is a need to enhance the alert mechanisms for quarantined batches for re-distribution in DDMS to avert wastage.
Quality control system	Operations standardized; procurement manual available. Supplier accountability ensured, and sample testing through empanelled NABL-certified labs followed.	Operations fairly standardized; procurement manual not developed. Supplier accountability ensured, and sample testing through empanelled NABL-certified labs followed.
Condemnation process efficiency	Defined incineration protocols. Timely condemnation process by waste management agencies.	Defined condemnation procedure through empanelled agencies. Substantial delays led to dead-stock accumulation.
Forecast		
Forecasting approach	Expert committee finalizes EDL. DDMS driven estimation at TNMSC level. Lack of objective data to appraise forecast rigor at the health facilities.	Collaborative forecasting exercise with indent estimates prepared by facilities, aggregated by District and State team, and submitted to KMSCL.
Utilization of digital tools	Limited facility-level forecasting via DDMS	DDMS-integrated indenting
Forecast accuracy (%)	Data not maintained by the HCFs, and retrospective data from TNMSC was not retrievable for analysis	104.12%

Indicator	Tamil Nadu	Kerala
Change in consumption (%)	Indicators included in the second phase of data collection - hence data not retrieved from TN during the study	24.46%
Change in financial allocation (%)		29.79%
Procurement		
Procurement model	Volume-Based Procurement and value-based indenting through passbook system. Procurement orders de-linked with financial year cycle.	Annual e-Tender model with categorized lists. Procurement orders strictly linked with financial year cycle.
Tendering process	Global tender with L1 and matching bidders	Competitive tendering with priority bidders. Integration of Kerala State Drugs and Pharmaceutical Ltd in bidder pool as per State policy
Supplier engagement	Multi-vendor pool to ensure supply continuity.	Bid items managed through empanelled suppliers, and No Bidder Items through Karunya Sales Wing of KSMCL.
Local purchase system	Emergency purchases with DDW approval	Local purchases done through LSGD and HMC funds, mostly from Central/ State government-owned enterprises.
Local purchase reliance (%)	Limited, regulated via DDWs	7.41%
Distribution and Logistics Management		
Number of DDWs at the time of assessment	32	16

Indicator	Tamil Nadu	Kerala
Inter-Warehouse Transfers	Facilitated by the TNMSC head office through real-time monitoring via DDMS	Facilitated by KMSCL head office through real-time monitoring via DDMS
Indenting Mechanism	Paper-based	Digital indenting via DDMS
Supply Scheduling	Weekly, monthly, quarterly – depending on the level of care.	Monthly/Quarterly – depending on multiple factors.
Overall logistics management	Although TNMSC has the mandate, mostly managed by HCFs except Chennai.	Mostly done by KMSCL. Facilities manage logistics using LSGD/HMC support for meeting emergency requirements.
Reverse Logistics	Limited, facility-managed	Facility-managed
Inventory and Stock Management		
DDW infrastructure	Industrial standard, high storage capacity	State-of-the-art, but excessive deadstock accumulation
Buffer stock maintenance	Maintained through year-round, flexible procurement cycle	Mostly sufficient at district level, but stockouts observed during FY transition period
Stock accuracy	102.04% as verified in 47/51 facilities	99.94% as verified in 49/50 facilities
Digital stock records	Observed in >60% of facilities, manual records co-exist	Fully integrated, but delayed updates impact accuracy
Inter-facility transfers	Prevent wastage, minimal losses in FY 22-23	Automated expiry alerts, transfers minimize wastage
Stock losses	Minimal, primarily due to quality failures	Minimal, primarily due to quality failures

Indicator	Tamil Nadu	Kerala
Stock Availability (Stockout Rate)		
Stockout rate on assessment day (%)	4.74% (pooled), highest in Coimbatore (12.85%), least in Namakkal (0.11%)	16.26% (pooled), highest in Palakkad (34%), least in Thrissur (7.75%)
Facility type with highest stockout rate	AAM-PHCs (6.20%)	AAM-PHCs (18.40%)
Facility type with least stockout rate	SDH (0)	DH/GH (4.90%)
Tracer medicines reporting the highest stockout rate	Diazepam (10.14%), Inj. Ceftriaxone (10.13%), Salbutamol (11.33%)	Pantoprazole (31%), Amitriptyline (29%), Diclofenac (26%)
Tracer medicines reporting the least stockout rate	Atorvastatin (0), Ciprofloxacin (0), Enalapril (0), Metformin (0), Paracetamol (0)	Inj. Ceftriaxone (1.51%), Amlodipine (1.72%), Paracetamol (1.72%)
Stockout episodes (FY 22-23)	2–7 occurrences per medicine	Data retrievable from only 16% of facilities
Cumulative stockout days (FY 22-23)	Varies significantly across districts and facilities (3-214 days)	Data retrievable from only 8% of facilities (12–209 days)
User Perspectives: Availability and Quality		
Prescription fulfilment rate (%)	98.46%	83.35%
Highest fulfilment facility type	SDHs (100%)	DH/GHs (84.25%)

Indicator	Tamil Nadu	Kerala
Highest fulfilment by conditions	NCD (98.74%), CD/ID (97.74%)	NCD (81.86%), MNN (56.25%)
Primary reason for incomplete fulfilment	Out of stock (75%)	Out of stock (85.15%)
User satisfaction with medicine quality (%)	95.07%	89.73%

KEY ENABLERS AND BARRIERS

The IT-enabled SCM systems in both Tamil Nadu and Kerala represent mature and contextually adapted models, demonstrating significant advances in ensuring the availability of essential medicines. While both States have established robust frameworks leveraging technology, they also share common challenges that require strategic attention for enhanced efficiency and effectiveness.

System Enablers

1. A primary enabler across both States is the foundational integration of Information and Communication Technology (ICT) into the core SCM processes. This has created robust databases for analytics, enhanced transparency, and enforced accountability. In Tamil Nadu, the long-standing, in-house management of their SCM software has allowed the platform to evolve organically with organizational needs, providing a significant advantage in data-driven decision-making. Kerala has built upon this by making strategic, forward-looking investments in infrastructure through its State Digital Health Mission (e-Health Project), enabling an ICT-driven SCM model that is resilient to contextual challenges like terrain. The widespread adoption of the DDMS platform in Kerala is paving the way for broader e-Health initiatives.
2. Strong governance and well-defined processes are central to the success of both systems. Standardized protocols, clear role definitions, and quality assurance mechanisms have been institutionalized. Tamil Nadu utilizes a comprehensive Procurement and Quality Assurance Manual and a dynamic forecasting model that decouples procurement from the rigid financial year cycle, ensuring consistent inventory levels. Kerala's governance framework is distinguished by its effective convergence with Local Self-Governing Departments (LSGDs) and other line departments, fostering a shared social-value system and promoting contextually aligned capacities among stakeholders.
3. Finally, both States have implemented agile and responsive procurement and distribution strategies to safeguard against supply chain shocks and improve

access. Tamil Nadu employs global tendering and maintains a pool of suppliers for every item, alongside strategic outsourcing of functions like logistics and analytical testing, to ensure system resilience. Kerala utilizes a dual-pronged procurement approach, empowering HCFs with the flexibility for local purchases through LSGDs for emergencies, while also fostering local production by prioritizing not-for-profit government entities for these purchases. The establishment of Karunya Community Pharmacies within KMSCL further enhances affordable medicine access for the general public.

Areas Requiring Attention

1. Despite the robust digital frameworks, a key area requiring attention is the persistence of manual processes at the facility level, which creates operational inefficiencies. In Tamil Nadu, HCFs are often required to maintain both digital and manual records, increasing the workload on pharmacists and fostering resistance to digitalization due to issues like poor internet connectivity and server lags. In Kerala, while the e-Health project is promising, practical challenges such as power outages and network latency lead to a concurrent use of hand-written prescriptions, causing discrepancies between real-time stock data and actual availability.
2. Shortfalls, training gaps, and increased workloads of human resources for health impact the efficiency of SCM operations at the ground level. Across Tamil Nadu, regular pharmacist shortfalls lead to deputation at primary HCFs, task-sharing and rationalization of existing staff at secondary HCFs, which keeps pharmacies operational but often at the cost of effective stock management and record-keeping practices. While Kerala generally has adequate staff numbers, increased workloads and administrative delays, particularly in remote locations, contribute to inefficiencies. There is a recognized need to re-evaluate HRH strategy based on evolving operational requirements.
3. Logistics and infrastructure limitations at the last mile hinder the seamless flow of supplies. In Tamil Nadu, HCFs often bear the responsibility and cost of arranging transport from DDWs, leading to delays and additional expenses, particularly for pharmacists. In Kerala, the success of the SCM system has led to a volume of medicines that exceeds the existing storage capacity at many primary and community-level facilities, creating spatial constraints and affecting the work environment.
4. Finally, non-standardized clinical practices at the point of care can undermine the SCM system's effectiveness. In Tamil Nadu, highly variable prescription practices, including the use of shorthand and branded medicines outside the Essential Medicines List, can lead to mismatches with available stock, resulting in local purchases or patients not receiving the intended medicines. Kerala also faces challenges with prescription practices not always aligning with actual stock, an issue exacerbated by data distortions between electronic and manual systems. A need for standardized prescription practices that account for e-Health implementation is evident.

RECOMMENDATIONS

General Recommendations

Process Standardization and Infrastructure: States to implement robust and standardized SCM processes at the centralized procurement level. This implementation should prioritize strengthening infrastructure, human resources, governance, supply chain networks, technology, and operational procedures. States to ensure the implementation of standards for storage capacity, infrastructure, specialized equipment, security, and fire-safety, as outlined by NHM guidelines for planning and establishing Drug Warehouse.[3] States to adapt a uniform approach where the penetration of IT based SCM is ensured up to the level of Ayushman Arogya Mandir Sub Health Centres (AAM-SHCs). This would strengthen the SCM practices by effective linkages across the levels of care, thus, enhancing overall supply chain efficiency. It is recommended that State specific models of IT-based solutions in SCM are integrated with DVDMS for uniformity and ease of functionality.

Operational Precision and Accountability: States to mandate and ensure adherence to protocols for inventory receipt, storage, and issuance, as these measures can significantly enhance operational precision, foster accountability, facilitate tracking, and reduce wastage.

While States may adapt the National Essential Medicines List (EML) to ensure effective service delivery across all levels of care, States are encouraged to align it with State health priorities and make it responsive to contextual needs and requirements.

Robust Governance Frameworks: States to develop explicitly detailed SCM governance frameworks that map stakeholder responsibilities and liabilities. These frameworks must incorporate quality assurance measures and performance standards to ensure accountability and efficiency. A State-level mechanism for routine monitoring to be ensured to review overall supply chain management across districts including stock availability, storage practices, emerging gaps and action taken reports. States to routinely evaluate the status of implementation of free drugs service initiative.

Effective intersectoral convergence would be a critical factor in enhancing the governance mechanisms, and thus to be explored at both State and district levels. In addition, States may undertake a mapping of resources in terms of available fund within NHM and relevant line ministries for effective implementation.

Human Resource Optimization: Adequate placement of human resources is vital for seamless SCM operations. HRH appraisals should extend beyond population norms to account for operational demands and assigned activities. Strategies to retain HRH within the public sector must be prioritized, as this is a critical enabler for the successful implementation of SCM practices. States are encouraged to involve the SIHFW/SHSRC (where functional)/LMS to impart requisite SCM training and skills to the concerned cadre. States with centralized systems may consider specialized

3. https://qps.nhsrcindia.org/sites/default/files/2022-05/NHSRC%20Drug%20Warehouse.pdf

SCM training programs for student doctors and pharmacists.

Accurate Demand Forecasting and Procurement: Addressing demand-supply mismatches, often due to data biases in ICT platforms, is paramount. States should identify, document, and address these biases to ensure that indented estimates align with actual demand. Periodic revision of essential medicine lists and multi-stakeholder consultations are recommended during procurement finalization. Training of healthcare providers and concerned facility staff on forecasting and procurement to be prioritized and expedited at State level.

States are encouraged to adopt a rolling forecast and procurement strategy, de-linked from the financial year, to effectively avert predictable shortages. Centralized procurement agencies must establish norms, thresholds, and funding sources for local purchases. Transparent processes for emergency demands should be promoted to mitigate wastage. A national level guidance on forecast and procurement strategy may be developed to guide States/UTs on the same for effective programme implementation.

Distribution, Logistics, and Prescription Practices: States to maintain a focused attention on distribution and logistics management, as this is crucial for supply chain efficiency. Efforts should alleviate the logistical burden on HCFs regarding supplies from collection hubs. States need to standardize prescription norms and streamline prescription audits as outlined in the national guidelines[4] to enhance care quality and patient safety. Training of concerned human resources at both primary and secondary level of care to be expedited for effective distribution, logistics and prescription practices.

User review and Feedback: States/UTs to utilize the existing platforms of patient experience surveys including both IT-based (Mera Aspataal) as well as manual patient satisfaction reviews being undertaken across all levels of care. Under Rogi Kalyan Samiti (RKS) and Jan Arogya Samiti (JAS) the existing practices of community-based interventions to be leveraged to ensure availability of medicines across HCFs. A regular State level review on the reports generated from the aforementioned platforms of patient satisfaction surveys to be undertaken for early identification of gaps and timely interventions to address the same. It may be noted that under the Kayakalp initiative weightage has been defined for patient satisfaction surveys – which needs to be leveraged and used for improving supply chain management practices.

4. https://nhsrcindia.org/sites/default/files/2021-07/1534_Prescription%20Audit%20Guidelines16042021.pdf

State-Specific Recommendations

Tamil Nadu

Digital Platform Implementation: While infrastructure investments are adequate, the State may revisit digital platform implementation strategies and clearly outline the expected outcomes. A phased, structured digitalization strategy is recommended to maximize both supply chain and service delivery benefits. The State may also consider prioritizing a process-flow approach for SCM ICT platforms, rather than a compartmentalized one, to improve interoperability. Furthermore, efforts need to be made to ensure stable internet connectivity at HCFs especially if robust digitalization strategies are envisioned.

Human Resource Development: The excessive workload on the regular pharmacist cadre requires immediate attention. The State needs to address shortfall of regular pharmacists for SCM to distribute responsibilities and offset this workload. State and District-level functionaries should undertake a training needs assessment to address skill gaps and improve existing capacity-building activities. Data Entry Operators at District Drug Warehouses, despite their proficiency with the DDMS portal, could also benefit from training on simpler tracer item analyses for monitoring.

Forecasting and Procurement Refinement: Given DDMS availability, periodic analysis of forecasted consumption, indented quantity, and actual consumption alignment should be undertaken to assess system effectiveness. The State may guide HCFs in scientific forecasting and systematic documentation of forecasting exercises when raising indents. The State may also ensure advance coordination with central agencies when implementing programmatic changes to prevent undue effects on routine SCM activities.

Logistics and Prescription Practices: The State should prioritize transport investments to strengthen logistics management of supplies and dead stock. Operational efficiencies in logistics may be enhanced through route-planning and pooled distribution. The "MTM scheme," involving door-to-door NCD medicine distribution, warrants an assessment of supply network changes and their SCM impact.

The State should standardize and streamline prevalent prescription practices, and prescription audit guidelines may be referred for provider orientation. Furthermore, prescription retrieval practices need to be replaced with other data capture mechanisms for tallying consumption, so that the users have access to written prescription slips guiding therapeutic regimen. The State may also allocate dedicated funds to ensure the availability and use of medicine dispensing covers/envelopes for written instructions.

Kerala

E-Health and Interoperability: Considering e-Health's pivotal role in hospital workflows and the supply chain, the State may undertake implementation research to identify deployment enablers and barriers. Strengthening current implementation

and refining the rollout strategy are essential to avert challenges and ensure seamless interoperability between DDMS and the pharmacy module of e-Health.

Infrastructure Development: State to undertake a gap analysis of HCF layout, location, spatial capacity, and storage structures to guide infrastructure expansion and weather-proofing solutions. Prospective HCF investments should also consider anticipated demand and supply growth to maintain Supply Chain Management (SCM) efficiency.

Human Resource Allocation: Redefining HRH adequacy in alignment with operational demands and equitable work distribution is critical. The State may evaluate its existing HRH positioning strategy to also consider the operational demands and the volume of activities, especially given the exponential increase in SCM activity. Prioritizing regular cadre pharmacist placement is crucial, particularly for HRH availability in remote areas, even though contractual postings may provide interim solutions.

Demand-Supply Database and Procurement: While significant progress has been made in developing a longitudinal demand-and-supply database via DDMS, the State is recommended to regularly review and validate assumptions and methodologies used in forecast generation. Introducing greater flexibility to the annual indenting framework is recommended to better align procurement decisions with real-time needs.

Establishing clear purchase conditions for government-promoted not-for-profit entities involved in local purchases may be considered to ensure alignment with the overarching SCM goal of medicine availability. Implementing a rolling forecast and procurement plan that staggers procurement activities may be considered to address recurring deficit scenarios. State may also consider de-linking the procurement cycle from the financial year timeline, as practiced by TNMSC, to mitigate supply shortages during the transition months.

Dispensing and Prescription Practices: Until the e-Health platform is fully streamlined, the State may guide the HCFs to adopt a medicine-centric dispensing log for effective aggregation and tracking of dispensed medicine units. This will facilitate real-time stock monitoring and better decision-making.

The State needs to address existing implementation gaps that contribute to prescription practice variability. Reinforcing guidance for prescription audits and disseminating best practices in e-prescription auditing, as demonstrated by some HCFs, can promote wider adoption.

PROGRAMMATIC IMPLICATIONS FOR SUPPLY CHAIN MANAGEMENT

Supply chain activity efficiency differs between centralized and HCF levels. While SCM is a dedicated function at the central agency level, it is merely one aspect of broader service delivery at HCFs, thereby increasing implementation challenges at this latter point.

A 'health systems' approach to SCM enhancement necessitates comprehensive evaluation of infrastructure, human resources, and key supply chain activities. To improve HCF-level SCM, States can adapt and integrate the Key Performance Indicators (KPIs) from this study for comprehensive supply chain assessment. This approach moves beyond evaluating performance solely by 'Stockout rate,' providing nuanced understanding and enabling system-wide improvement efforts.

Suggested KPIs include:

- **Infrastructure:** Availability, Functionality, Exclusivity for SCM activities, and adequacy appraisal.
- **Digital platforms:** Access, functionality, and exclusivity for SCM activities.
- **Forecast accuracy:** Comparison of a fiscal year's (FY) indent with the previous FY's recorded consumption (proxy to forecast data).
- **Procurement:** Percentage of orders procured through the centralized agency; percentage procured through local purchases.
- **Quality compliance:** Quantity/value of unusable stock due to quality failure (DDW and HCFs).
- **Warehousing and inventory management:** Stock accuracy of physical units against reporting; quantity and value of unusable stock due to expiry or damage.
- Plan for predictable change in demand: Qualitative data.
- **Distribution:** Quantity of order fulfilled in each indenting cycle (quarter/annum); quantity of supplies received from sources other than the designated collection hub (i.e., DDW/Drug Stores).
- **Logistics management:** Qualitative data on availability of transport support; frequency and associated costs.
- **Human resources:** Availability against State norms and IPHS; turnover rate; vacancy rate; recruitment against vacancy; positions managed through deputation/ task-shifting/task-sharing.
- **Record maintenance:** Sources maintained (digital, manual, dual); availability of main-stock and sub-stock records.
- **Stock availability:** On the day of assessment; during the assessment period; and cumulative stockout days for the assessment period.

Data from these KPIs for tracer items, including medicines, can enable gap and performance analyses, identify contextual enablers and challenges, and guide preventive and corrective actions.

INTRODUCTION

A supply chain (*SC*) can be considered a quasi-organization and an activity system formed by a large number of diverse and dynamically interacting entities, like companies, end-users, and technologies.[1,2] It can be defined as *a set of organizations that coordinates purchase, production, and distribution activities, aiming to create an added value for the final user*.[3,4] The achievement of this end goal is possible only if all stakeholders espouse *efficiency* and *effectiveness* in their respective operations. In supply chain, efficiency refers to an internal standard of performance, while effectiveness refers to an external standard of fit to various groups' demands.[2]

Supply chain management (*SCM*) involves planning and overseeing activities like sourcing, procuring, processing products, and managing logistics. It also includes coordination and collaboration with channel partners like suppliers, intermediaries, third-party service providers, and customers. In essence, SCM integrates supply and demand management within and across companies.[5]

Supply chain management in the context of health services is intricate due to factors such as inherent health systems complexities; the use of an extensive range of products for service delivery; and the need to keep pace with evolving technologies.[6] Furthermore, SCM in healthcare systems has a *distinctive social relevance* as their reliability and stability directly impact public health.[1]

In healthcare service delivery, robust SCM implementation empowers the providers to execute two seemingly contrasting objectives of *efficiency* and *responsiveness* with measurable and positive outcomes. For instance, by optimizing cost through efficient SCM, the healthcare service providers can divert resources into patient quality improvement and other innovative ventures, which in turn, can enhance the providers' brand equity and generate more demand.[7]

In striving for efficiency and responsiveness, health sector supply chain initiatives often prioritize reducing costs and enhancing process adaptability. This narrow focus has led to under-investments in sector-wide digitalization and logistics management. Digitalization is particularly crucial as it ensures smooth information exchange among stakeholders, enhancing the management of physical flows. There is no doubt that the health sector too stands to benefit from strategic digitalization efforts, as growing evidence highlights its positive role in the functioning of healthcare supply chains [1,3,8]

Digitalization efforts in the field of SCM include the adoption of traditional technologies such as Enterprise Resource Planning, Distribution Resource Planning, Electronic Data Interchange, and Electronic Catalogs, as well as recent elaborate technologies such as cloud computing, Internet of Things and Artificial Intelligence.[3] These technologies are expected to improve the benefits of linking stakeholders in the supply chain, synchronizing information and material flows, optimizing time, and improving SC flexibility and agility. Some of the technologies are even considered

to have positive long-term effects on clinical performance.[3]

Nevertheless, there is a need for an in-depth evaluation of the role of digitalization on SC processes and performance in the health sector. The need has been acutely felt in the public health systems of developing economies like India's, given the prevalence of diverse health system resource optimization approaches.

In India, the Ministry of Health and Family Welfare has been supplementing State-specific efforts to improve access to free, affordable and quality healthcare. Under the aegis of the National Health Mission (NHM), concerted efforts have been directed towards improving access to medicines and diagnostic services in public healthcare facilities. Some of them include the strengthening of procurement and logistics mechanisms, implementing quality assurance and feedback mechanisms, and Information and Communication Technologies (ICT) platforms like Drugs and Vaccines Distribution Management Systems (DVDMS).[9] Currently, the assistance to strengthen the State's SCM practices is routed through dedicated programmes like the Free Drugs and Diagnostic Service Initiatives.[10] The central funding through these programs supports the integration of ICT for generating demand, schedules and purchase orders; strengthening logistics such as transport, warehousing and inventory management; and positioning skilled human resources for SCM.

With an increasing thrust towards sector-wide digitalization efforts, the Ministry of Health and Family Welfare expressed its interest in understanding and documenting the role of digitalization on SC processes, management and performance in the Indian public health system, specifically for the States of Tamil Nadu and Kerala. The annual NHM Common Review Mission reports and independent literature have documented various good practices of the States' centralized agencies for SCM, including their early adoption of ICT platforms for their SCM systems, making them ideal subjects for this study.[11–14] Hence, a cross-sectional study was conducted to understand the IT-enabled SCM systems of Tamil Nadu and Kerala catering to the needs of their public healthcare facilities.

SCOPE AND RATIONALE

Supply Chain Entities: The SCM practices of the States are centralized at the level of their respective *Medical Service Corporations*. The Tamil Nadu Medical Service Corporation (*TNMSC*) and Kerala Medical Service Corporation Limited (*KMSCL*) are government-owned companies established specifically for the management of supplier sourcing, demand planning and forecasting, logistics and distribution planning, product and process flexibility and quality assurance of a variety of healthcare service products such as medicines, vaccines, equipment, reagents, and consumables for public healthcare facilities and community pharmacies. [15,16] The District Drug Warehouses (*DDWs*), operationalized by these agencies were also included for the assessment.

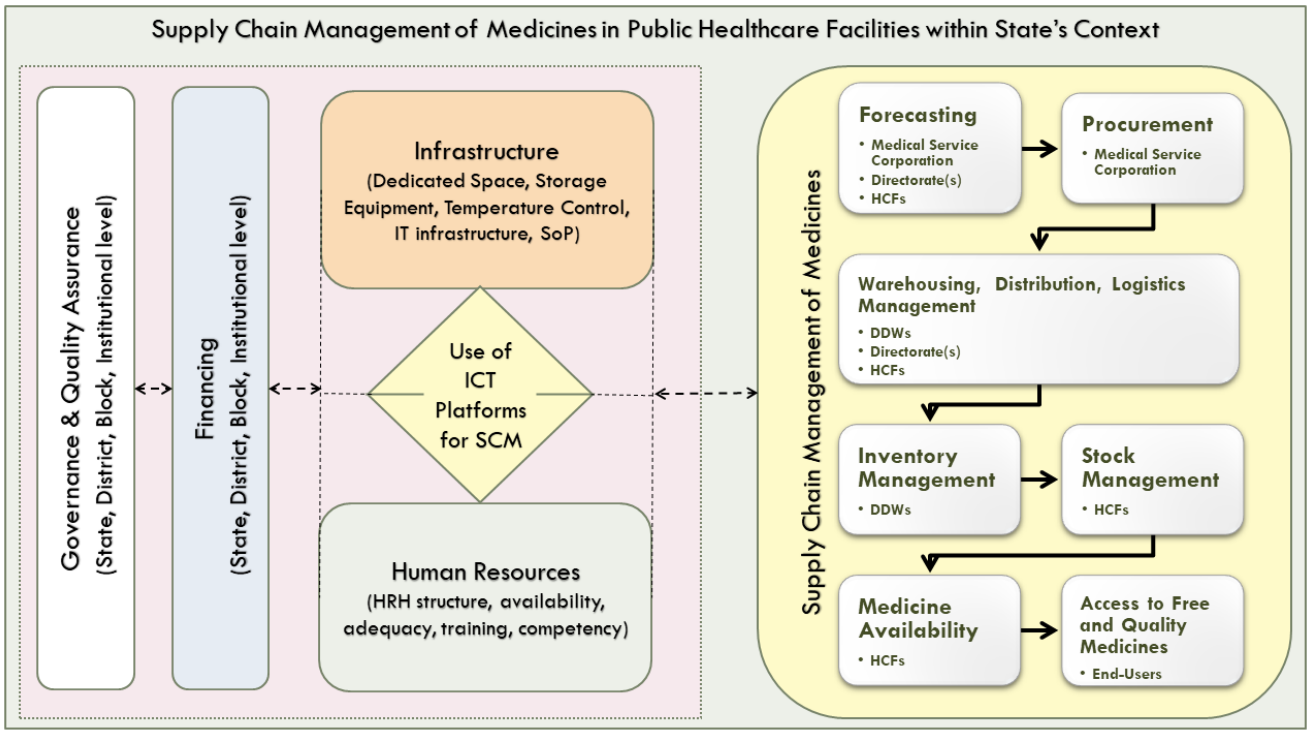
Type of healthcare facilities: Following consultations with the respective States, the assessment focused *primary* and *secondary allopathic healthcare facilities* under *NHM*.

Medicine categories: Although the public healthcare facilities of the States provided essential medicines, specialty and anti-cancer medicines, the assessment was done only for *essential medicines*, as by definition, these should be available, affordable and of assured quality at all times to treat the priority healthcare needs of the population. Also, their inclusion controls for variability in medicine categories across the levels of care, and facilitates a uniform assessment of medicine availability regardless of hospital types.

Supply Chain Activities: Considering the extensive range of activities involved in the SCM of medicines, the study narrowed its focus to understand forecasting, procurement, inventory and stock management, distribution, and the role of ICT platforms in these key supply chain processes.

Cross-cutting areas: The study assessed the availability of *infrastructure* and *human resources*, and the role of *governance* (including quality assurance mechanisms), and *financing* mechanisms for the States' SCM of medicines.

ASSESSMENT OUTLINE



OBJECTIVES

Primary

- *To understand the IT-enabled Supply Chain Management model for medicines adapted by the states of Tamil Nadu and Kerala*
- *To understand the State-specific models' performance in specific SCM activities*

Secondary

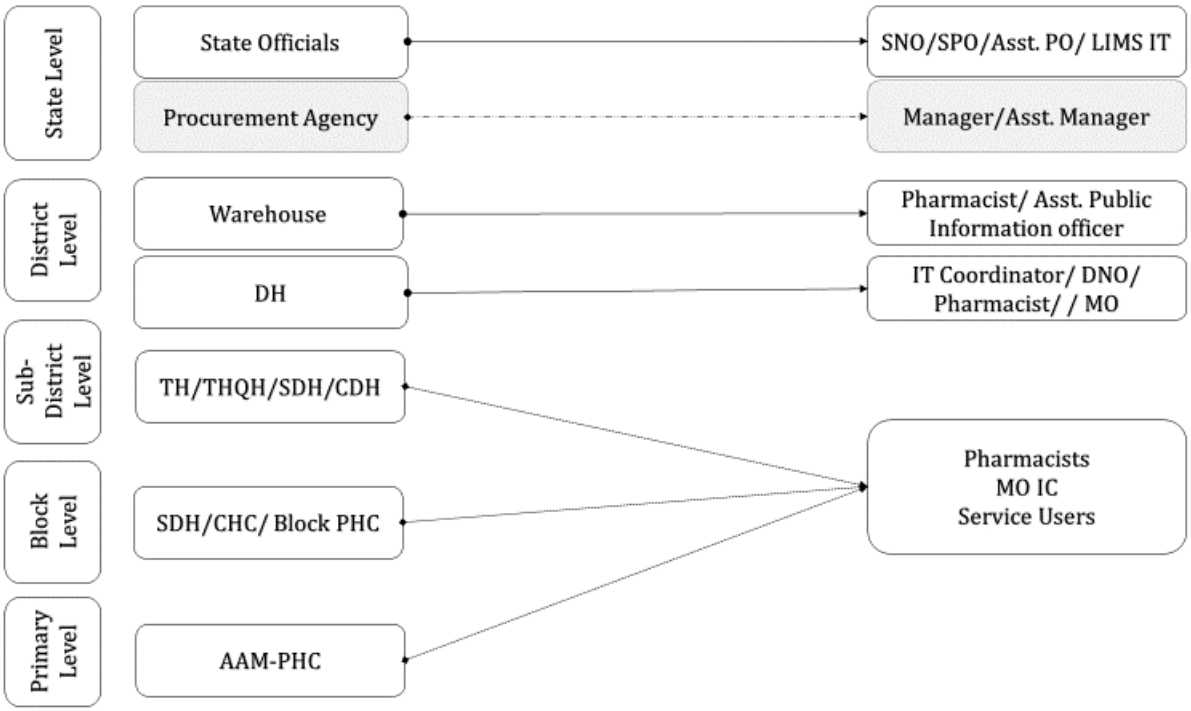
- To *assess the availability of medicines in healthcare institutions under NHM*

METHODOLOGY

Study design: The assessment was designed as a cross-sectional study using mixed methods. The study intended to draw quantifiable insights from legacy reports, current reports and end-user interactions, and qualitative perspectives of relevant stakeholders for data contextualization.

Study respondents: To answer the objectives, a preliminary mapping of stakeholders was done based on available literature and consultations with the State *(See Figure 1)*. During data collection, interactions were organized with other pertinent stakeholders as and when identified, especially in Kerala, which included members of the local self-governing bodies, store verification officers, and senior officials of the Department of Health Services.

Figure 1: Tentative Stakeholders Identified for Each Level of Assessment



SAMPLING STRATEGY

The study adopted a multi-stage cluster sampling strategy. As highlighted earlier, the selection of States was done purposively as per the study objectives. The States have relatively robust public healthcare infrastructure, high utilization rates and good health indicators. Further, the States institutionalized a centralized system for the healthcare supply chain management and were early adopters of ICT platforms for supply chain operations.

Selection of Districts

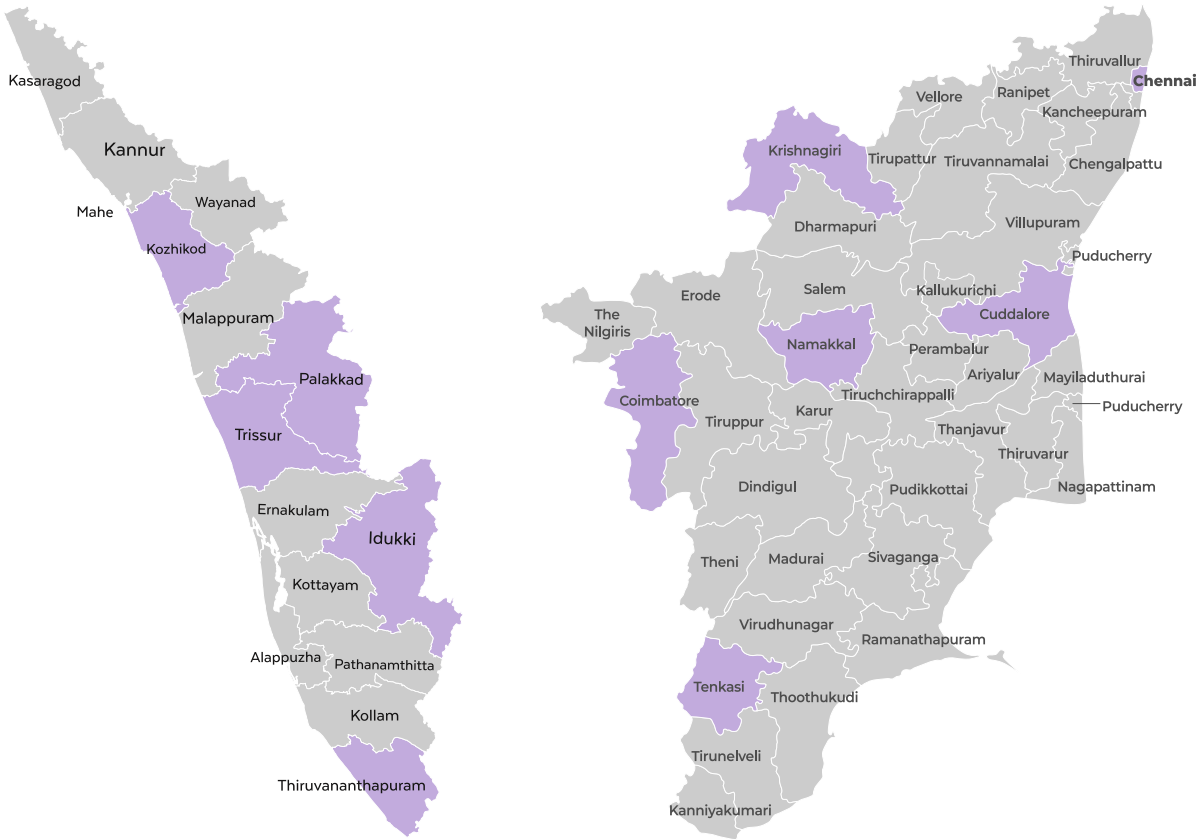
A combination of geographical and demographic criteria (i.e. population size, rural, urban and tribal demographics, and geographical terrains) was used for the selection of districts. Each State was broadly divided into the *North*, *Central* and *Southern zones*, while the terrains were categorized as *coastal* and *main lands* (non-coastal).

Using these stratification criteria, districts in both States were grouped under clusters. *14 districts of Kerala* were grouped under five clusters, namely the *Northern Coastal, Central Coastal, Southern Coastal, Northern Non-Coastal* and *Southern Non-Coastal.* Whereas, *38 districts of Tamil Nadu* were grouped under six clusters, namely the *North & North-East Coast, East Coast, South & South Coast, West, North-West* and *Central*.

The capital districts of Kerala and Tamil Nadu (Thiruvananthapuram and Chennai) were selected purposively since the Head Office of the State's Medical Service Corporation are located there. Excluding them, the districts within the remaining clusters were categorized based on the combined estimates of their district size, urbanization levels and tribal population from the 2011 Census, and were then selected randomly.

Following these steps, the districts selected from Kerala were Idukki, Kozhikode, Palakkad, Thrissur, and Thiruvananthapuram. The districts selected from Tamil Nadu were Chennai, Coimbatore, Cuddalore, Krishnagiri, Namakkal, and Tenkasi *(See Figure 2)*.

Figure 2: Selected Districts in Kerala and Tamil Nadu



Selection of Facilities

Sample Frame

The Master Facility Lists (*MFL*) were retrieved from the State's Health Departments. The secondary level healthcare facilities included General Hospitals (*GH*), District Hospitals (*DH*), Taluk Hospitals (*TH*), Taluk Head Quarters Hospitals (*THQH*), Sub-Divisional Hospitals (*SDH*), Community Health Centres (*CHC*) and Block Primary /Family Health Centres. For the primary level of care, only the Ayushman Arogya Mandir - Primary Health Centres and Urban Primary Health Centres (*AAM-PHCs/ AAM-UPHCs*) were included. Using the inclusion criteria, a list frame was constructed and the established sampling universe had *464 facilities in Kerala* and *546 in Tamil Nadu.*

Study units

Each district was divided into clusters based on the administrative divisions (Taluks/ Zones). Two clusters were selected in each district. One cluster in each district was selected randomly, while the cluster with a DH/GH was included by default. Whereas for districts with more than one cluster with a DH/GH, a random selection was employed. Within each cluster, primary and secondary level facilities were selected using a combination of systematic sampling and probability proportionate to size (PPS). The total number of facilities sampled under each type was proportionate to their overall number in the district. The sample size was calculated using the formula, n = [[(z2 * p * q) + ME2] / [ME2 + z2 * p * q / N]]*d – where z is the confidence level at 95% (1.96), ME is the margin of error (15%), p is the anticipated proportion of facilities with the attribute of interest (0.5); q is 1-p (0.5), d is the design effect (1.2) and N is the sample frame of Kerala (464) and Tamil Nadu (546).[17] The total sample size calculated was *50 facilities for each State*.

This method ensured representation across eligible facility types. The GH/DH were oversampled relative to other types of facilities, as using the same sampling fraction would lead to a small sample of GH/DH resulting in data too unreliable to report. The resulting sample included *5 GH/DH, 5 TH/THQH, 10 CHCs and 30 FHCs* across the districts. However, the number of facilities covered under each type *(See Table 1)* varied slightly due to the field realities. As there were no DH/GH in Chennai, an additional SDH was selected. Also, some of the primary health centers were being upgraded to secondary level during the time of assessment.

Table 1: Final Number of Facilities Covered in Each State

Facility Type	Kerala (50, N=464)	Tamil Nadu (51, N=546)
DH/GH	5 (N=11)	5 (N=5)
SDH/THQH/TH	5 (N=31)	7 (N=46)
CHC/ Block PHC/ Block FHC	11 (N=87)	9 (N=83)
AAM -PHC/UPHC	29 (N=335)	30 (N=412)

Selection of Users

Anticipating variability in user footfall across different levels of care and times of day, the assessment targeted 4-6 users per facility. This included individuals who received prescribed medicines from the facility after a physician consultation, or simply obtained medicines from the facility on the day of the assessment. The study covered *241 users from Kerala* and *269 from Tamil Nadu*.

Data Collection Methods

Data Collection Tools

The selected SCM activities were assessed on relevant key performance indicators (KPIs) adapted from literature and validated tools[18–21] *(See Annexure 1)*. A semi-structured tool was developed for assessing each activity. An in-depth interview guide was prepared to acquire qualitative information on State-specific practices, and a semi-structured questionnaire was developed using an open-source platform for end-users visiting the facilities.

To ensure comparability between the States, it was essential to standardize the units of measurement. Given the differences in the Essential Medicine Lists across the levels of care, the KPIs were uniformly quantified using a few tracer medicines to represent common diseases. The tracer medicines were selected using reference literature and National EML. [15,16,22,23] After piloting, the list was further modified and finalized to include 13 tracer essential medicines. While the tracer list remained consistent for both States, minor variations were introduced to ensure coherence with the local contexts *(See Annexure 2)*.

Most of the data collection instruments were pen-and paper based. Semi-structured tools were used for retrieving information from legacy reports of the financial year 2022-23; and current reports of the financial years 2023-24 (Tamil Nadu) and 2024-25 (Kerala).

Data Collection Methods

Secondary data were retrieved from digital and manual records available at the facilities. In cases where both manual and digital records existed, digital records were prioritized. Detailed in-person interviews were conducted with key informants, and audio recordings were made after obtaining informed consent. Further discussions were held with related stakeholders identified during the data collection process. Exit interviews with end-users were conducted using an open-source mobile app-based tool (Epicollect5), with the data stored in a cloud environment. Additionally, field-level observations were noted to contextualize the data analysis

Data Analysis and Presentation

Data collected through pen-and-paper methods were transferred to an MS Excel sheet. This double-entry method ensured data validation. Responses collected via the open-source app were retrieved from cloud storage. All quantitative data were then cleaned. Weighted and unweighted analyses of the indicators were carried out using MS Excel and STATA (v.16). Descriptive statistics (Mean, linearized standard error, median, min-max, IQR) along with 95% confidence intervals (where applicable) have been generated to analyze the reports.

Audio-recorded interactions with stakeholders were transcribed and translated into English. The qualitative data were analyzed and presented under both pre-determined and inductive themes. Data from discussions with providers and field notes have been utilized to strengthen the interpretation of the quantitative data.

Ethical considerations

Permissions were obtained in advance from the respective State-level authorities for provider and user interactions. Participants were briefed on the study objectives, data collection process, expected outcomes, and confidentiality terms. Informed consent was obtained from willing participants. The data was anonymized prior to storage and analysis. The presented data focuses on State-specific SCM practices and the perspectives of both supply and demand-side stakeholders.

Report Structure

The report is organized into six sections. The first section provides an overview of supply chain management (SCM) activities in India's public healthcare system, establishing the context for the analysis. The second and third sections delve into the State-specific practices of Tamil Nadu and Kerala's SCM systems, respectively. The fourth section discusses the study's limitations. The fifth section outlines key recommendations for strengthening existing systems and highlights good practices for cross-learning and adaptation by other States. Finally, the sixth section emphasizes the importance of using various key performance indicators (KPIs) to comprehensively assess supply chain systems, aiming to support effective strengthening and implementation.

OVERVIEW OF SCM ACTIVITIES IN INDIA'S PUBLIC HEALTHCARE SYSTEM

Supply chain management activities in India's public health system are variable across the country. Procurement management is widely done through centralized mechanisms of the governments, such as through government-owned autonomous bodies, procurement cells of the governments or public-private partnership arrangements. Logistics management is usually assigned to designated regional or district-level actors. Additionally, facilities may utilize resources like untied funds or local governing body funds for undertaking local or emergency purchases.

An analysis of the Common Review Mission Reports[24] illuminated a recurring field-level observation that States with autonomous bodies for SCM show relatively improved governance, decreased wastage and improved availability of quality medicines with lesser financial burden on the end-users. Other SCM models face relatively more constraints to meet district level demands, resulting in delays and disproportionate local purchases. Even among States with procurement bodies, their efficiency in achieving desirable outcomes is tied to the availability of *clear directives* (e.g. drug policy, procurement policy, notification of free medicines, prescription guidance, STPs), *essential medicine list* for each level of care, *flexible financial and purchasing empowerment* for the providers, and *robust logistics management* strategies.[12]

In Indian public health system's context, some of the desirable and cost-effective SCM practices include: multi-stakeholder formulation of State-specific EMLs; scientific demand forecasting; institution of a transparent tender and bidding system; enforcing compliance standards; and leveraging IT-based platforms for SCM and logistics management. These IT-based platforms have shaped *estimation, tracking* and *monitoring* practices for medicines, equipment and consumables in Indian health system. Early adoption of such platforms has promoted skill development and skill refinement among its users, allowing the States to gradually saturate and implement them throughout.[12]

Health system inputs and processes substantially affect SCM and logistics management. SCM efficiency was modulated by the availability of adequate infrastructure for logistics; availability of adequate and skilled human resources for health; pooled procurement practices for vertical and horizontal health programmes; and through intra-sectoral convergence, information sharing and systematic reporting across programmatic platforms.[12]

Inefficiencies and challenges arise due to deficiencies in health system inputs, processes and SC activities implementation. Practices like normative or empirical demand forecasting, fragmentation of procurement sources, and outsourcing procurement to agencies lacking technical competency cause operational inefficiencies. Implementation gaps like variable quality assurance mechanism, and a lack of established linkages for logistics management affect the supply of quality

medicines at the right time and in desired quantity to the healthcare facilities. These inefficiencies and challenges contribute to differential access to affordable and quality medicines in the public health system.[12]

Nevertheless, the National Health Mission has been driving sector-wide reforms to ensure access to affordable and quality medicines for all users of public healthcare facilities. Through the implementation of the Free Drugs Service Initiative (2015) and subsequently the Comprehensive Primary Health Care (2018), NHM has been providing technical and financial assistance to the States for strengthening their SCM practices, IT-based platforms and strengthening of essential health system inputs to supplement SCM activities.[25,26] These programmes have been instrumental in improving the effectiveness of healthcare services delivery, while at the same reducing the share of OOPE due to medicines.

TAMIL NADU

STATE CONTEXT

Under the Department of Health and Family Welfare (*DoHFW*), the operations and oversight of the public healthcare facilities (*HCFs*) have been channeled to the Directorates of public health and preventive medicine (*DPH*); medical and rural health services (*DMS*); and medical education (*DME*). Primary health care facilities and Community Health Centres come under the jurisdiction of DPH, Sub-divisional and District Hospitals under DMS; and tertiary level hospitals like Medical Colleges and some secondary hospitals of the Municipal Corporations under the DME. The district level functionary of the DPH is the Deputy Directorate of Health Services (*DDHS*); and of DMS' is the Joint Directorate of Health Services (*JDHS*). In highly urbanized areas, the Municipal Corporations are the reporting authorities of both primary and secondary healthcare facilities. The City Medical Officer and the City Health Officer are the zonal authorities under the Municipal Corporation.

The Tamil Nadu Medical Service Corporation, established in 1995, is an independent body under the DoHFW for regulating drug procurement and distribution to all government healthcare facilities. The directors of DPH, DMS, DME and State NHM are among the key members of TNMSC's Board of Directors. The TNMSC operations are funded mainly by the State Government. World Bank, a Development Partner, provides funds for project-based procurements (TNHSRP). NHM is a major funding source for the routine procurement of general medicines.

The operations of TNMSC's head office are supported by an ICT platform called the Drugs Distribution Management System (*DDMS*). The software was developed in-house to perform most of the transactions related to the TNMSC's supply chain and quality divisions, thereby, bolster transparency and efficiency in the procurement, payment, quality control and inventory management processes. The in-house team routinely updates the platform to fix technical issues and improve user-friendliness. Intimation of software updates is communicated through mail.

The DDMS platform links the head office with all district drug warehouses (*DDWs*) under it. This linkage facilitates simplified reporting by the warehouses, which function as the point of receiving medicines from the vendors, and distribution of supplies to the public healthcare institutions in the districts. The IT wing of TNMSC oversees DDMS and addresses all technical issues at the portal. TNMSC has extended DDMS to facilities under DPH since FY 22-23, to facilitate monitoring of stock at the HCFs by the Directorates.

Since TNMSC also manages the supply chain of equipment and consumables, it has developed a portal called the Electronic Equipment Management System (*EEMS*), which has been extended to public health facilities.

INFRASTRUCTURE

Hardware

The study assessed the availability of essential infrastructure for the SCM of medicines at the HCFs. Further, their functionality and exclusivity for SCM activities were recorded. *Figures 3 and 4* illustrate the general availability, functionality and exclusivity of infrastructure for SCM activities across facilities.

While each facility could benefit from the infrastructure items identified for SCM of medicines, their availability did not necessitate their use in the State context. Further, the exclusivity of infrastructure for SCM varied across the levels of care.

Most of the facilities had adequate infrastructure with dedicated spaces for storing and dispensing medicines. The facilities had sufficient hardware for entering programmatic data (desktop, laptop, tablet or smartphone) in a digital format; power-back up; and equipment for maintaining and monitoring the temperature of thermo-liable medicines and vaccines. It was observed that these were exclusively allocated for the pharmacies and main store of secondary facilities, whereas, for primary facilities, they were common for the facilities' use. Though the government has made provisions for the facilities' internet access, most of them reported network instability and high latency. *It observably hindered seamless portal use and perpetuated a conservative attitude towards digitalization*. The same concern was raised by the DDWs, as *network-connectivity issues impeded the routine workflow*.

Infrastructure

Figure 3: Infrastructure Status (%) - Hardware; Facility-type aggregate

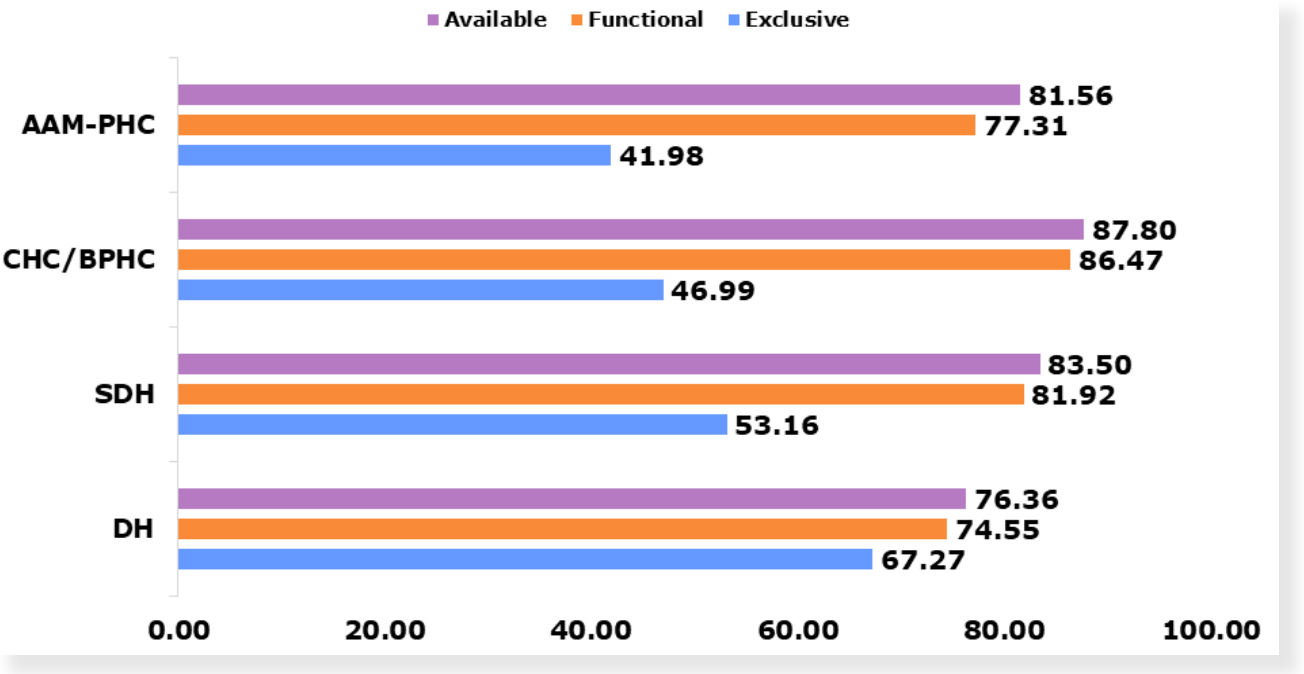
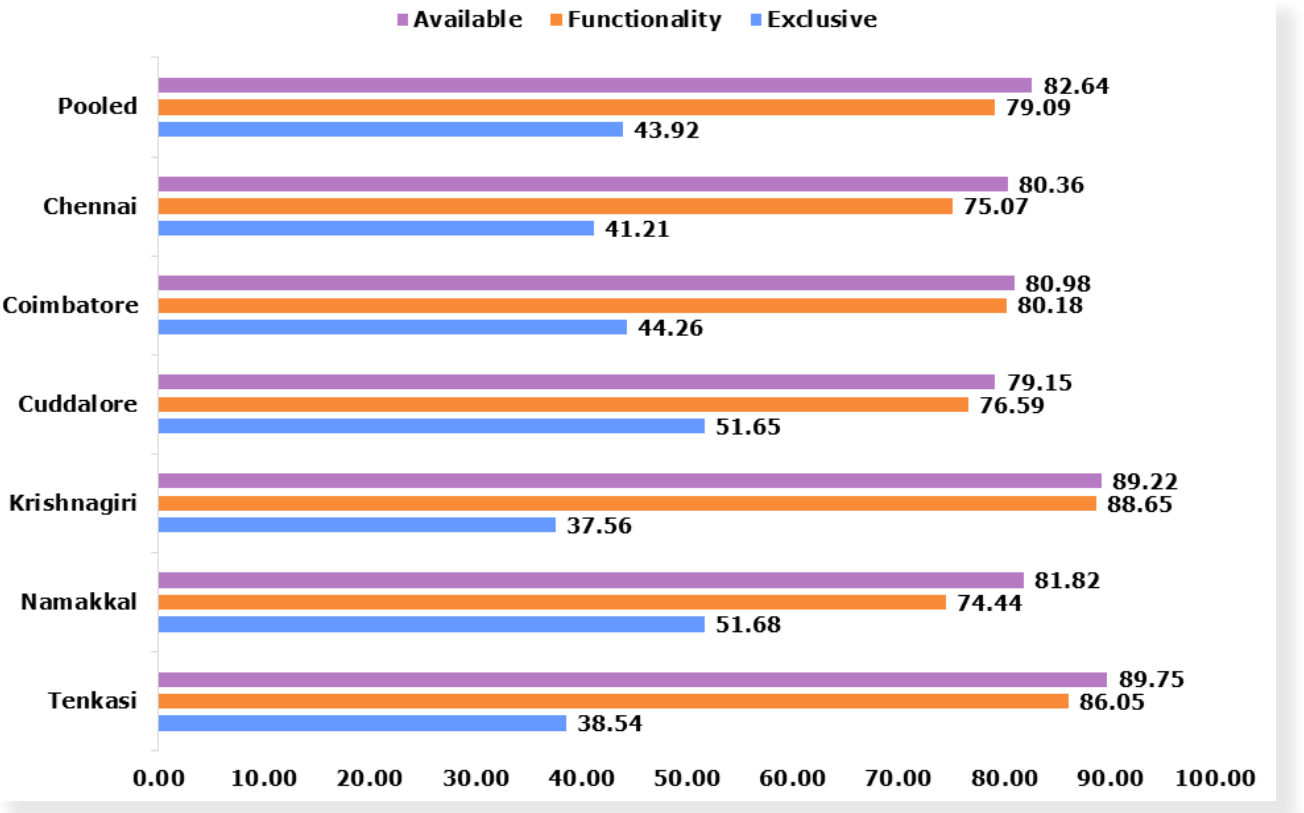
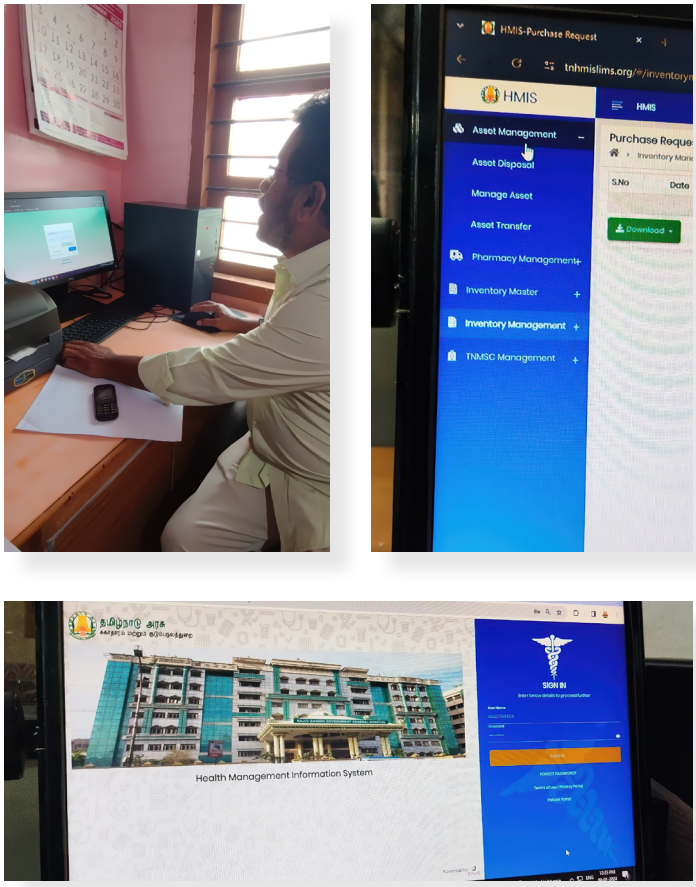


Figure 4: Infrastructure Status (%) – Hardware; District aggregate



Software

The study assessed the accessibility and functionality of IT platforms that supplement SCM activities within the State. These platforms include: Drug Distribution Management System (*DDMS*), Health Management Information System (*HMIS*), Electronic Vaccine Intelligence Network (*eVIN*), Family Planning Logistics Management Information System (*FPLMIS*), Equipment Maintenance & Management System (*EMMS*) Of these, DDMS, eVIN, and FPLMIS were specifically dedicated to the SCM of medicines, vaccines, and family planning products, respectively. *Figures 5 and 6* illustrate the access, functionality, and exclusivity of these portals for medicine SCM in the State.



HMIS & DDMS

Figure 5: Infrastructure Status (%)- Software: Facility-type aggregate

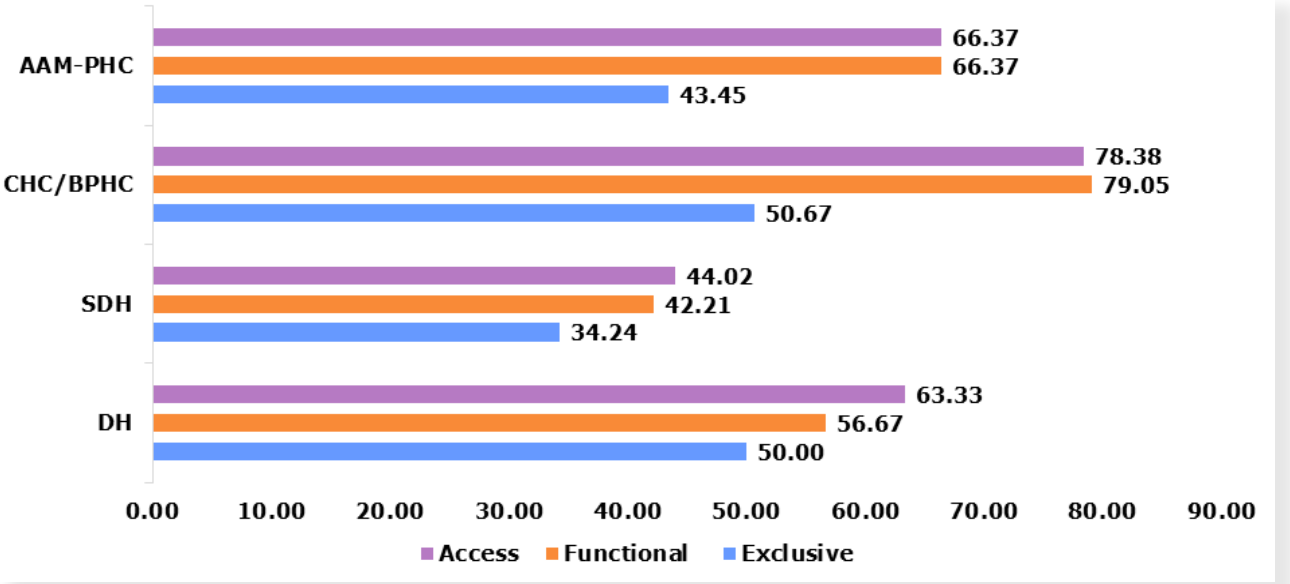
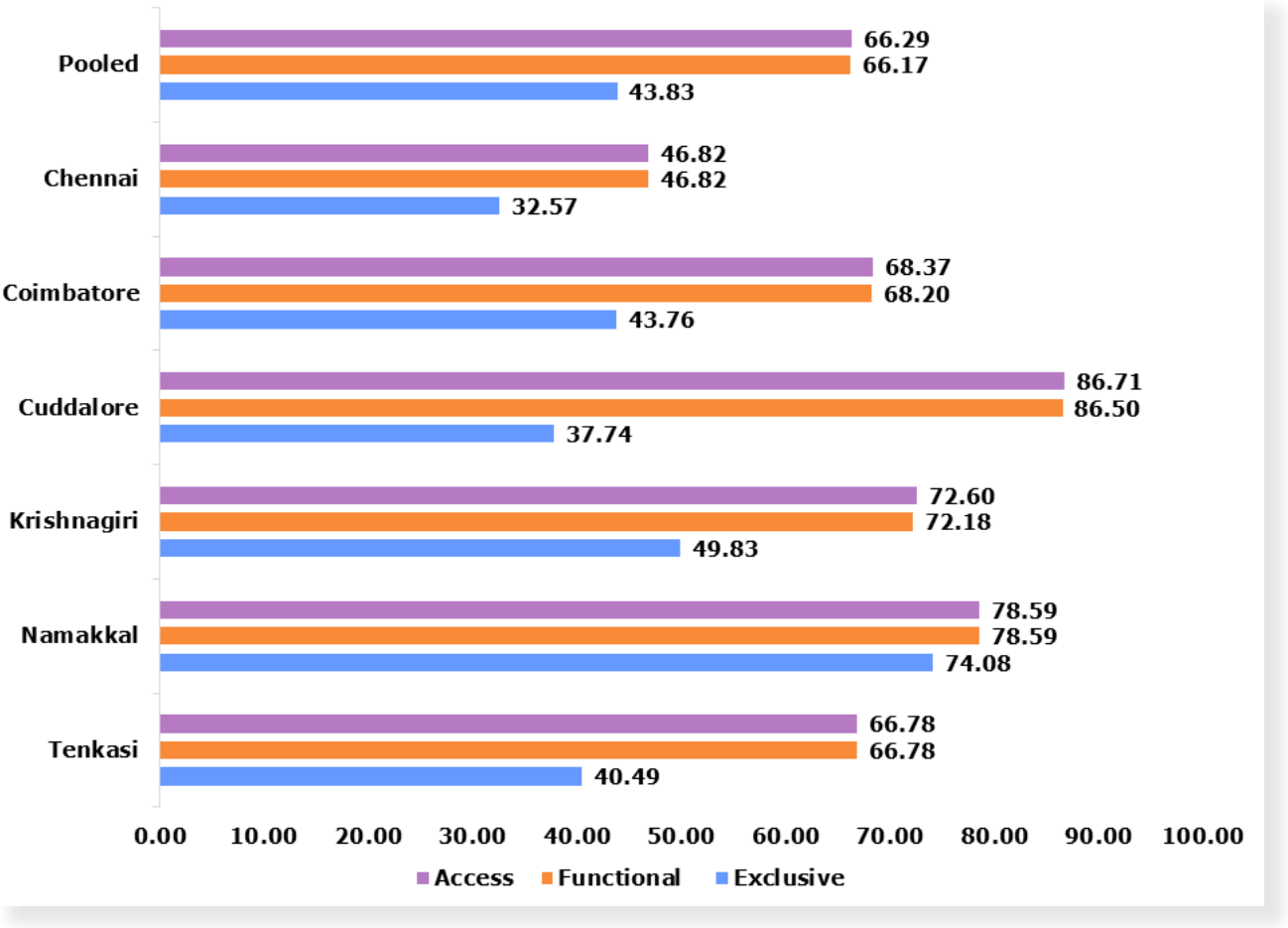


Figure 6: Infrastructure Status (%)- Software; District aggregate



The implementation of digital platforms for SCM was found to be variable in the State. The DDMS portal at primary HCFs was observed to function as an electronic record. The portal's utility has been restricted to maintaining stock record of medicines. The HMIS portal, which was operational in some secondary HCFs, was a hospital management system. Its implementation was differential across the districts, and its uptake was variable. It was reported that an extension of the TNMSC's DDMS portal, called the MEDWIS, is being rolled-out in the State's tertiary level facilities under the DME, which facilitates online indenting. HCFs visited under the Greater Chennai Municipal Corporation were yet to implement digital platforms for their SCM activities.

The utility of these platforms for NHM facilities was limited, with little interoperability with TNMSC's DDMS. It was reported that DDMS for the HCFs was developed on a needs-basis, without a definite plan for robust integration with TNMSC's DDMS. This likely explains the lack of investment in the software to serve as a permanent SCM interface for the HCFs. As a result, *dual record maintenance was prevalent*, although manual record-keeping practices were predominant and quite robust.

At the institutional level, the HMIS portal allowed the main drug store to monitor stock

movement and availability across wards and dispensaries. At the district and State levels, the HMIS reports were monitored by the JDHS and the DMS, respectively. A commonly reported concern was the frequent technical glitches encountered by HCF users in the revised versions of the portal compared to the initial version. Due to this, some experienced end-users admitted having reservations about moving away from manual registers, given the reliability they offered in retrieving information. However, *some providers awaited the streamlining of the platform to offset the burden of manual record-keeping*. Some even suggested expanding the portal's utility for online indenting and coordination with the warehouses by providing interoperability.

HUMAN RESOURCES FOR SUPPLY CHAIN MANAGEMENT

HRH Structure

TNMSC and DDWs

At the TNMSC head office, the General Manager – Drugs has been assigned the responsibilities for medicine SCM. The Senior System Manager of TNMSC's IT wing oversees the DDMS portal. The Manager Purchase, responsible for procurement, is deputed from the Drug Control Department. The positions of Assistant Manager Purchase at the head office and Medical Store Officer and Warehouse Manager at the DDWs are filled through transfer posting of senior pharmacists under DME or DMS for a specified duration. The Data Entry Operators (DEOs) at TNMSC and DDWs were a mix of State and contractual employees.

Healthcare Facilities

The regular-cadre pharmacists were in charge of SCM for supplies to the facilities, including medicines, while the contractually posted pharmacists managed the hospital pharmacies. In urban areas, Zonal Pharmacist posts were created to coordinate with the District and Corporation Authorities, while contractual pharmacists were assigned to AAM-UPHCs and UCHCs.

The State's staffing norms for the pharmacists are shown below *(Table 2)*.

Table 2: Tamil Nadu's regular pharmacist staffing norms

HCFs	Medical Store Officer	Chief Pharmacist	Pharmacists
DH	1	1	2-3
SDH	0	1	2-3
CHC	0	0	2
AAM-PHC/UPHC	0	0	1

Training

At the DDWs, training for the pharmacists in-charge was reportedly provided by the TNMSC HO every quarter. However, *the capacity-building activities for the pharmacists at the HCFs were observably are not comprehensive*. The district-level authorities reported that monthly training was provided to the pharmacists for SCM of medicines. However, the HCF pharmacists reported receiving little training for utilizing the portals. *Many senior-grade pharmacists visibly struggled to navigate the portals signaling the need to align the training activities to cater to their requirements*.

For HCFs under the Municipal Corporation, initiation of training for record-keeping through the IT portal was reported, however, the awareness or consensus on the same was lacking among the zonal officials.

It was observed that the *State provides hands on training to interning pharmacists at the DDWs and HCFs for inventory management*, a good practice for the HRH seeking to serve in the public health system.

Availability and Adequacy

As the SCM of medicines is predominantly manual in the HCFs, its efficiency depends on the availability and retention of skilled personnel at the facilities. *Table 3* presents metrics of HRH for SCM of medicines in the State. There was a shortage of regular pharmacists across all levels of care, with slight variability across the districts. There was no HR shortage in Cuddalore. In Chennai, the Greater Chennai Municipal Corporation recruited contractual pharmacists for the AAM-UPHCs and noticeably had fewer vacant posts.

The turnover and vacancy rates were highest at the DHs. The indicator 'vacancy rate' only highlights the vacancy that was not filled throughout FY 22-23. Interactions with the providers confirmed that some facilities had vacancies for over a quarter due to delayed HR posting. Also, recruitment for vacant positions was sparse (<50%) during FY 22-23, due to the reported ongoing lawsuit related to pharmacist recruitment.

HRH

HCFs without regular pharmacists in position ensured continued service delivery through other mechanisms. The pharmacies and stores at AAM were managed by Staff Nurses (task-shifting) for routine operations, and by deputing a regular pharmacist on specific days (HR rationalizing) to raise indents and record material-inflow into the facilities. In secondary-level HCFs, the stores were managed by the existing pharmacists (task-sharing).

The availability and adequacy of HRH throughout the year were crucial for stock management and record-keeping

(both physical and digital) at the HCFs. It was noted that stock management and record-keeping were robust in facilities where the pharmacists have been retained for a substantial time, or with staff nurses trained in pharmacy management. Arrangements like deputation or HR rationalization could, at best, keep the pharmacies functional, while the concurrent monitoring of stocks and record maintenance often suffered due to HR shortfalls.

HR structure at DDWs was reportedly insufficient and so the staff took on additional responsibilities to streamline workflow. The DDWs in charge highlighted the need for additional staff, particularly a Medical Store Officer to strengthen monitoring and ensure efficient work allocation.

Table 3: HRH Status – Tamil Nadu

HRH Status	Availability Ratio (N=51)		Turnover rate (N=43)	Vacancy rate (N=51)	Recruitment for vacancies (N=51)	Deputation /Task-shifting /Task-sharing (N=51)	
	Regular cadre	Total (R+C)				% Positions against sanctioned	% Facilities observed doing this
Districts							
Chennai	0.75	0.996	0.45	0.22	83.94	2.44	9.76
Cuddalore	1.00	1.000	0.00	0.00	14.07	0.00	0.00
Krishnagiri	0.35	0.408	1.75	46.27	28.97	67.04	67.04
Coimbatore	1.00	0.997	0.00	14.20	77.25	10.78	18.63
Namakkal	0.85	0.848	0.00	15.15	10.61	29.70	44.24
Tenkasi	0.63	0.633	0.00	36.72	1.64	38.69	45.57
HCFs							
DH	0.94	0.99	13.33	15.71	40.00	60.00	40.00
SDH	0.89	0.90	1.21	9.47	46.74	0.00	0.00
CHC/BPHC	0.47	0.72	0.00	32.05	40.59	50.85	77.78
AAM - PHC	0.83	0.89	0.00	11.68	48.57	14.67	18.02
Pooled	**0.78**	**0.865**	**0.28**	**14.46**	**47.19**	**19.06**	**25.31**

GOVERNANCE

The governance mechanisms were robust within the TNMSC functionaries as the operations of TNMSC were based on standardized protocols. It is important to note that TNMSC's responsibility is defined only up to the level of the DDWs. Though a simpler version of the DDMS portal has been extended to the primary health facilities, TNMSC has not been mandated to monitor the HCFs.

At the district level, the District Health Society reportedly holds a monthly meeting

with representatives from the District Drug Warehouse (DDW), the Deputy Director of Health Services (DDHS), the Joint Director of Health Services (JDHS), and pharmacists/store in-charge for reviewing medicine requirements. Yet, the providers at the HCFs might need additional support and supervision from district level authorities. For instance, HCFs reported that they were asked to stop prescribing an NSAID drug, even in its tablet form (Diclofenac Sodium), and it was consequently excluded from the facilities' indents. The original communication shared by the State through an advisory was to only regulate the use of the NSAID injection. However, the information passed down from the district level authorities to the HCFs was lost in translation, which affected the supply chain. Such events underscore the need for enhanced communication channels, additional training and support, and a system for monitoring and feedback.

The DDWs in-charge are accountable for verifying the received supplies as per the purchase order and for the inventory management of the medicines once received. Similarly, regular pharmacists are responsible for the same tasks at the HCFs. *Access to digital platforms is provided exclusively to the regular pharmacists, allowing only them to raise indents and accept supplies into the facilities*. While this mechanism enhances accountability and transparency, it requires adequate support through the prompt posting of regular cadres.

Quality Control

Quality management is an integral part of TNMSC's governance framework. The protocols enforce suppliers to adhere to performance conditionalities and quality standards. Performance conditionalities for labelling, boxing and packaging aim to promote transparency, mitigate supplier bias, enhance clarity in segregation and distribution. For the SCM of medicines, TNMSC has empaneled analytical testing laboratories with NABL accreditation for testing the quality of the procured medicines.

Sample testing for quality used a double-blindfold method. Once the DDWs receive the supplies are received at the DDWs, the Warehouse in-charge is mandated to number the corrugated boxes from the supplier and input the supply timeline and box numbers into the DDMS. This information is used to check the timeliness and completeness of the supplies as per the purchase order. For quality control, the software has been programmed to guide sample withdrawal. The DDWs must send the sampled boxes to the Quality Control Department at the Head Office within 2 days of its receipt. The same process should be repeated every 6 months if the stored medicines remain that long at the DDWs. Additionally, the TNMSC officers and State Drug Inspectors can draw random samples from the DDWs during routine inspections for quality testing.

The process confidentiality is preserved by masking the suppliers' details, assigning dummy codes, and ensuring non-disclosure of the empaneled laboratories. Further, the generation of dummy codes and random assignment of the batches to the empaneled labs are done through DDMS. The logistics are processed through an empaneled service provider.

The analytical test reports labelled the sampled medicines as *'Standard Quality'*

or *'Not of Standard Quality'(NSQ)*. The labs furnished the test reports within the stipulated time period of 8-21 days, depending on the medicine category. The soft and physical copies of the lab reports were sent to TNMSC.

Batches reported as *'Standard Quality'* are allowed for distribution to the facilities. The details shared in the form of *'Material Received Certificate'* in the DDMS is used to concurrently initiate payment to the vendors. To note, this process is followed in addition to the analytical report produced by the supplier while delivering the batches to the DDWs.

If a medicine batch is labeled as 'NSQ', its distribution is immediately suspended, and the sample testing is repeated to confirm the results. If the batch passes this re-testing, it is then integrated into the main stock for distribution. However, if the 'NSQ' classification is confirmed again, the entire batch is quarantined from the inventory at the DDW, and the supplier is formally notified to retract the batch from the DDW within a stipulated timeframe.

In cases where any HCF raises quality concerns about a medicine batch, TNMSC directs all HCFs possessing that batch to quarantine it immediately. Simultaneously, samples from the disputed batch are retrieved for quality testing. If the batch passes the quality test, HCFs are permitted to resume distribution. However, if it's confirmed as 'NSQ', the batch remains quarantined at the HCFs until the DDW retrieves it. If the batch has been fully consumed at the HCFs, the Head Office will issue a show-cause notice to the vendor, followed by a penalty.

If suppliers failed to remove failed batches from the DDWs within the stipulated time, TNMSC arranged for the incineration of the condemned medicines through biomedical waste management agencies approved by the State's pollution-control board. The cost of incineration was levied from the suppliers, and the value of the unusable quantities was deducted from their payment.

FORECAST

TNMSC finalizes the Essential Medicine List annually through *Drug Committee* meeting convened with various directorates under the DoHFW alongside representatives from HCFs. The committee scrutinizes and modifies the proposed items under Essential Medicines, Specialty drugs, Anti-hemophilic drugs, and suture items in terms of their demand, relevance, and movement in the facilities. Further, the committee consults with the Director of Drug Control to finalize the specification of each item to the pharmacopeia standards. The quantity forecasted for tenders is based on the analytical insights of the previous year's purchase and utilization provided by the DDMS portal at the TNMSC.

There was a lack of objective data to appraise the rigor of forecasts done at the HCFs. Forecasting was approximately estimated using the previous year's utilization patterns and patient load. The study observed that facilities did not record how medicine consumption was forecasted for the quarter or year. The digital platforms also did not aid in forecasting as they couldn't provide the aggregate data needed for such computations.

Information on the scientifically determined forecast was only with the TNMSC head office. However, it was not retrievable for the study, as the data was dynamic and subject to change with consumption (i.e., rolling forecasts). Therefore, it was not possible to conduct a straightforward analysis on the forecasting accuracy. *This existing situation made it difficult to analyse the alignment between forecasted demand, actual indent, and actual consumption across the supply chain.*

Figure 7: Balance availability against total availability for FY 2022-23

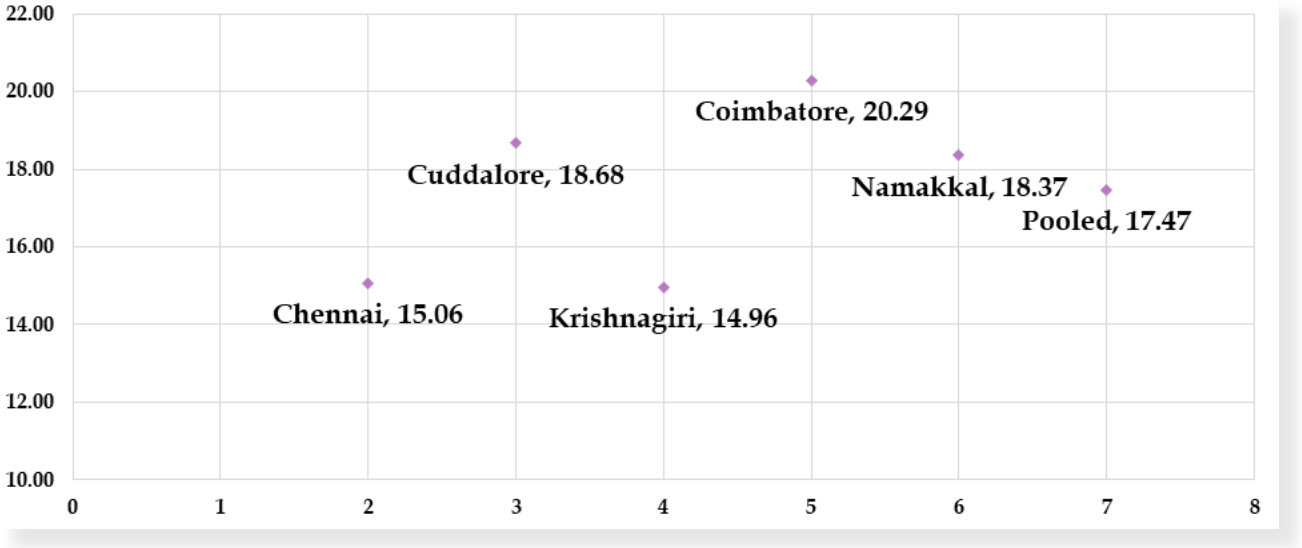
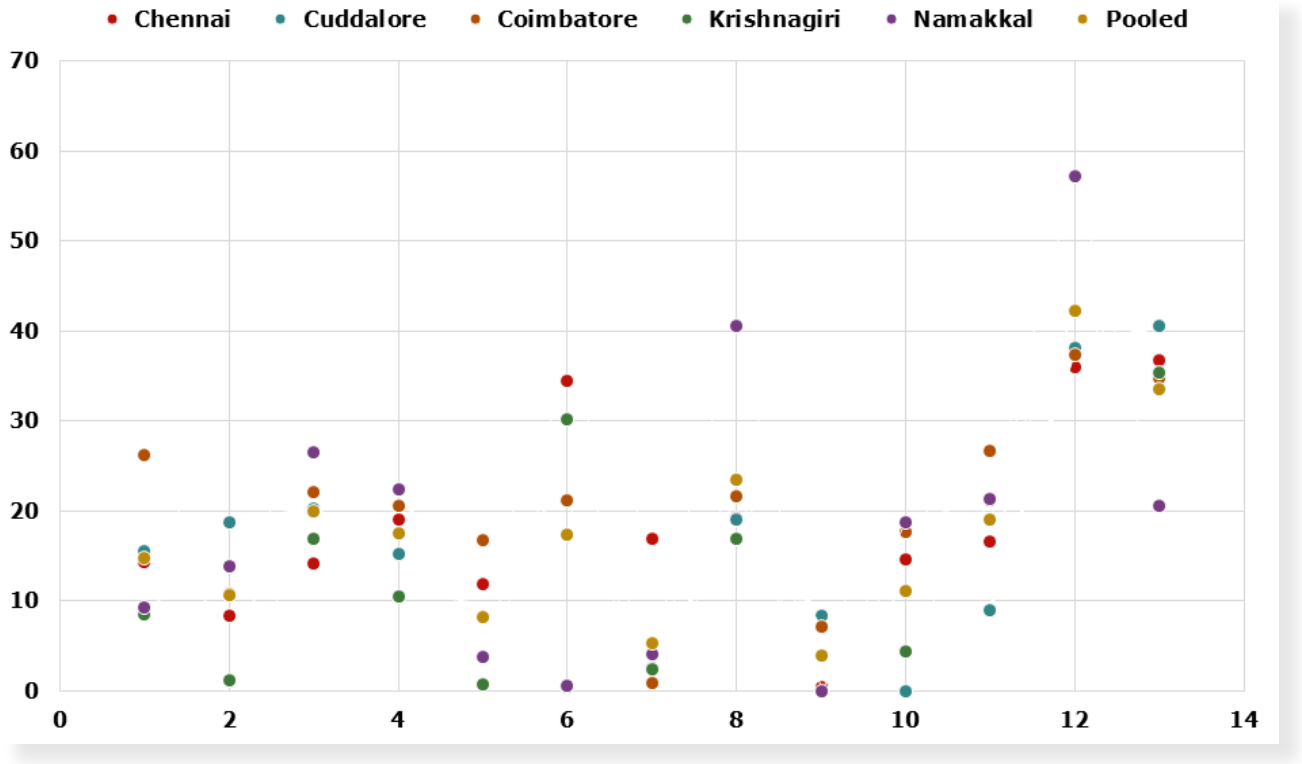


Figure 8: Balance stock of tracer medicines against total availability during FY 22-23 (%)



An indirect analysis of the adequateness of supplies to the warehouses, and thereby, to the facilities, was performed by estimating the balance quantity at the end of FY 2022-23 against its total availability during the year *(See Figure 3)*.

The aggregate data shows a balance of 17.47% of the total available stocks across the DDWs, implying a considerable adequateness of stock needed for the facilities' consumption. However, disaggregated data of the tracer medicines highlight a complete to near-complete issue of some medicines at the DDWs *(See Figure 4)*. This does not necessarily imply deficiencies in the forecasting exercise. Interactions revealed that external factors such as delayed supplies, retraction due to quality failure, programmatic changes, and unanticipated demand affected inventory and buffer stocks at the DDWs and the HCFs. Such externalities were reportedly managed by the HCFs through local purchases or the use of substitute medicines.

PROCUREMENT

The State follows a passbook system for procuring and supplying essential medicines under the general category as well as under various schemes. During FY 2022-23, primary level facilities (DPH) used approximately 23 passbooks, while secondary level facilities (DMS) used around 6 passbooks.

The TNMSC procures essential medicines monthly based on the *pre-order statement generated by the DDMS*. The procurement quantity is finalized based on the highest consumption estimate derived from either the preceding 365 days' or the preceding three years. The indents are raised to account for 4 months of physical stocks and 2 months of pipeline stock. In cases where data on past consumption was not available, procurement was based on the requirements submitted by the Directorates.

The State follows a *Volume Based Procurement System (VBP)*. Once the procurement quantity is finalized by the State, a global tender is solicited in the State's e-procurement portal, newspapers and State tender bulletin. L1 Bidders meeting the tender conditionalities and others willing to match the L1 rates are empaneled by TNMSC with variable purchase order quantities assigned to each group. This is reportedly done to maintain a pool of vendors for every single product throughout the year, and thereby, *ensure reserve suppliers to tackle unanticipated emergencies*

Table 4: Bundled unit cost of issuing procured tracer medicines to facilities under DPH and DMS (INR) – Population data

Districts	DPH (INR)	DMS (INR)
Chennai	3.3002	3.3519
Cuddalore	3.3082	3.3772
Krishnagiri	3.3208	3.3083
Coimbatore	3.2949	3.3541
Namakkal	3.2803	3.3079
Tenkasi	3.3039	3.3376
Pooled	3.3099	3.3295

Source: TNMSC

Table 5: Bundled unit cost of issuing procured tracer medicines to HCFs – Sample data

Bundled cost	n	Mean (INR)	L.SE	95% CI	
Districts					
Chennai	9	0.5348	0.0576	0.4133	0.6563
Cuddalore	8	1.5958	0.1682	1.2409	1.9507
Krishnagiri	8	1.6572	0.1364	1.3695	1.9449
Coimbatore	9	0.7986	0.1362	0.5111	1.0860
Namakkal	8	0.8220	0.1195	0.5699	1.0741
Tenkasi	8	0.6589	0.1873	0.2638	1.0540
HCFs					
DH	5	1.4902	0.2152	1.0362	1.9442
SDH	7	1.8773	0.1535	1.5534	2.2012
CHC/ BPHC	9	0.7679	0.1900	0.3671	1.1686
AAM - PHC	29	0.8506	0.1703	0.4913	1.2100
Pooled	**50**	**0.9304**	**0.1375**	**0.6402**	**1.2206**

Source: Sampled HCFs

or supply failures. The recruited suppliers are then linked with the DDMS, which allows them to track material receipts and payment sanctions. Purchase orders are communicated through e-mails.

Tables 4 and 5 below illustrate the average unit cost incurred for purchasing a bundle of tracer medicines for FY 22-23. The difference in the bundled cost for the districts and the sample facilities is due to the defined scope of the study under each directorate, and the differential demand for each tracer medicine. The figures are simply indicative of the costs incurred by the government when volume-based purchasing is done. *Interactions with TNMSC revealed that the VBP system has been sufficient to tackle demand variations with the introduction of new programs such as the MTM.*

At HCFs, all personnel responsible for formulating and approving the indents reported estimating the requirement by factoring in the consumption pattern, patient footfall, seasonal variations and required quantity of buffer stock. For instance, AAM in Cuddalore located close to tertiary facilities modified their indent preparation to cater to the users' demand. The only condition is that all indents need to be raised within the respective passbooks and their financial ceiling.

TNMSC has directed the HCFs to raise weekly, monthly or quarterly indents based on the level of care. This was facilitated by the DDWs by developing and sharing a roster with the HCFs for placing indents. However, all HCFs have been given the flexibility to raise emergency indents to meet immediate requirements, in coordination with the DDWs.

Table 6 shows passbook utilization (%) and quantity issued (%) against the total

indent placed by TNMSC to DPH and DMS facilities across the districts during FY 2022-23. *Table 7* shows indent fulfillment by TNMSC through passbook allocation across the sampled facilities.

Table 6: Passbook utilization and quantity issued to facilities under DPH and DMS

Districts	DPH		DMS	
	Passbook Utilization (%)	Quantity Issued (%)	Passbook Utilization (%)	Quantity Issued (%)
Chennai	63.10	86.07	100.86	89.64
Cuddalore	67.40	65.78	90.35	67.67
Krishnagiri	68.24	87.50	89.38	86.31
Coimbatore	64.66	86.85	98.63	73.55
Namakkal	72.57	84.21	90.36	86.50
Tenkasi	68.08	99.28	98.37	98.66
Pooled	**65.65**	**85.26**	**94.19**	**79.41**

Source: TNMSC

Table 7: Proportion of total receipt at HCFs through passbook indents

Fulfilment (%)	n	Mean	L.SE	95% CI	
Districts					
Districts		0.5348	0.0576	0.4133	0.6563
Chennai	9	90.82	1.60	87.44	94.20
Cuddalore	8	84.77	2.75	78.96	90.59
Krishnagiri	8	69.82	2.65	64.23	75.40
Coimbatore	9	84.46	5.63	72.59	96.33
Namakkal	8	65.19	5.21	54.19	76.18
Tenkasi	8	71.90	4.83	61.71	82.10
HCFs					
DH	5	96.38	0.44	95.44	97.31
SDH	7	97.37	1.23	94.78	99.96
CHC/ BPHC	9	65.22	5.37	53.88	76.56
AAM - PHC	29	81.82	4.15	73.06	90.58
Pooled	**50**	**80.71**	**3.47**	**73.39**	**88.03**

Source: Sampled HCFs

On average, 80.71% of the indents raised by the facilities were fulfilled during the scheduled visits to the DDWs. The facilities additionally received from the district level functionaries (DDHS, JDHS, and City Health Officer) who also procured from

the TNMSC. The quantity of medicines supplied through the district authorities was decided during the monthly review meetings. Further, the facilities met emergency requirements through inter-facility transfers. The combined estimates of the total quantity received against indents have been presented in the next section *(See Table 9)*.

Interactions with the providers at HCFs highlighted the need to revise the financial allocation for the 'General Medicines' passbook, especially at the AAM. *It is necessary to make the indenting more responsive to the changes in patient footfall and demand, and less reactive to medicine shortfall*. The distribution of medicines under the Makkalai Thedi Matruvam (MTM) scheme followed a push strategy, where the DDHS allocated the quantities of NCD medicines for each HCF based on the line-listed data of NCD beneficiaries. Though the additional NCD medicine influx had been helpful to meet immediate requirements, it also led to over-stocking at some facilities. While a blended pull-push strategy is desirable, it may be beneficial to revisit the specific contexts for employing push or pull strategies independently. This is particularly relevant given the discernible inefficiencies at the point of service delivery, especially at the primary level.

Local purchases were made only when the medicine requirements or shortfalls could not be met through these mechanisms. *The facilities resorted to local purchasing of essential medicines after confirming with the DDWs that the required medicines are not available with them*. The confirmation is issued by the DDW in the form of a 'No-Objection Certificate' (*NOC*) that is valid for a stipulated time frame. During FY 22-23, NOCs with a month's validity were issued for three tracer medicines. *This mechanism is enforced to disincentivize frequent local purchases*. Data on local purchases were maintained by the facilities; however, details of tracer medicines could not be segregated for analysis. A few retrievable data showed that the cost borne by the facility for each unit of drug purchased locally was 0.49 to 1.1 times higher than the unit cost of a bundled purchase.

DISTRIBUTION AND LOGISTICS MANAGEMENT

At the time of assessment, 32 DDWs have been established in the State, who act as the point of receipt, inventory, and logistics management of the supplies. The DDWs serve as a collection point of medicines from the empaneled suppliers; other DDWs during inter-warehouse transfers (IWTs), and the deadstock from HCFs for condemnation *(See Table 8)*. IWT is a mechanism of appropriating supplies from DDWs with excess to DDWs with deficits. This provision contains procurement cost and lead time; balances inventory and reduces wastage. This is facilitated by DDMS through real-time monitoring of DDWs' inventory at the head office. Transportation of IWT units is done through an

DDW

Table 8: Proportion of receipts from empaneled suppliers and IWTs (%)

Source	Empanelled Suppliers	IWTs
Districts*	Mean (%)	Mean (%)
Chennai	97.00	1.36
Cuddalore	96.85	2.08
Krishnagiri	88.27	11.08
Coimbatore	96.17	3.34
Namakkal	85.80	10.23

**At the time of assessment, Tenkasi district was catered by Tirunelveli DDW*

empaneled logistics service provider.

The DDWs functionaries play an important role in developing and communicating the rosters and the indenting frequencies with the HCFs. The HCFs currently follow a paper-based indenting system, which needs to be shared with the DDWs ahead of their allotted date. This would help the DDWs to ensure their availability for dispatch. On the allotted date, the HCFs' regular pharmacists need to visit the DDWs and physically verify the dispatch quantity before receipt.

For medicine purchases, the *TNMSC charges five percent of service charge from the State for the transportation of supplies from the DDWs to the HCFs*. Reverse logistics of dead stock alone need to be done by the HCFs. It was reported that transportation support is extended in the form of fuel cost reimbursement to the AAM (if they utilized government-owned vehicles), and by arranging vehicles for dispatch to the secondary level facilities. However, the HCFs in all districts, except Chennai, reported arranging their own means of transportation for receiving supplies. Pharmacists in these districts at times had to bear personal expenses for arranging pick-up vehicles which were reimbursed through the office or HMC fund. While in Chennai, logistics management was done by the DDWs. It appeared that the HCFs and DDWs in districts outside Chennai lacked awareness of the logistics management mandate under TNMSC. It is an overlooked implementation gap needing redressal. It was resource-intense in terms of time and cost. It directly affected service delivery at the HCFs; as well as work schedules and workload at the DDWs.

The amount of indent fulfilled during the scheduled visits depended on the timeliness of information sharing with the DDWs, availability of stock at the warehouse and the HCFs, availability of hired or pick-up vehicle for the HCFs, adequate capacity of pick-up vehicle to accommodate the receipt, adherence with allotted slot for collection, and the utilization levels permissible in the passbooks. Unscheduled visits were allowed only to fulfill emergency demands, provided the warehouse had sufficient stock.

Table 9 shows the quantity of medicines distributed to the facilities and their sources. *Table 10* shows the average indent fulfilment in each quarter and for the annum. The pooled median (IQR) indent fulfillment for the annum was 96.39% (12.36). Shortfalls in receipt can be observed in Cuddalore throughout the year.

Table 9: Supply sources to HCFs and quantity (mean%)

Source	HCF Passbook allotment	DDHS	JDHS	City Health Officer
Chennai	95.21	0.98	0.00	3.81
Cuddalore	82.31	15.68	1.97	0.13
Krishnagiri	79.26	17.70	3.01	0.04
Coimbatore	89.84	9.08	0.87	0.20
Namakkal	83.19	14.24	2.56	0.00

Source: DDWs

Table 10: Indent fulfillment (%) across financial quarters and total annual receipt during the FY 22-23 (direct and other sources)

Distribution	Q1	Q2	Q3	Q4	Annual
District	**Median (IQR)**				
Chennai	100 (20.10)	80.5 (16.67)	100 (2.50)	97.41 (9.08)	95.47 (10.88)
Coimbatore	90 (22.59)	96.10 (10.28)	90.21 (9.79)	89.45 (19.23)	90.32 (9.49)
Cuddalore	77.86 (19.94)	77.55 (13.12)	79.21 (10.31)	75.47 (31.37)	79.15 (20.55)
Krishnagiri	100 (7.69)	100 (3.33)	100 (16.06)	95.83 (13.13)	94.48 (10.23)
Namakkal	100 (0)	100 (1.58)	100 (0)	100 (0)	100 (0)
Tenkasi	100 (0)	100 (0)	100 (0)	100 (0)	100 (0)
HCFs	**Median (IQR)**				
DH	97.78 (10.00)	99.14 (3.86)	100 (11.93)	100 (9.67)	94.65 (22.55)
SDH	92.31 (20.10)	92.13 (16.21)	90.21 (15.46)	95.83 (14.17)	90.57 (14.27)
CHC/BPHC	100 (36.92)	100 (17.44)	100 (12.83)	90 (24.29)	86.31 (19.76)
AAM - PHC	100 (20.63)	94.29 (22.45)	100 (5.68)	100 (11.43)	98.79 (7.12)
Pooled	**100 (20.10)**	**96.40 (18.90)**	**100 (12.38)**	**100 (12.50)**	**96.39 (12.36)**

Source: DDWs

The *figure 9* shows the average quantity of medicine fulfillment during the FY 22-23 to the sampled HCFs.

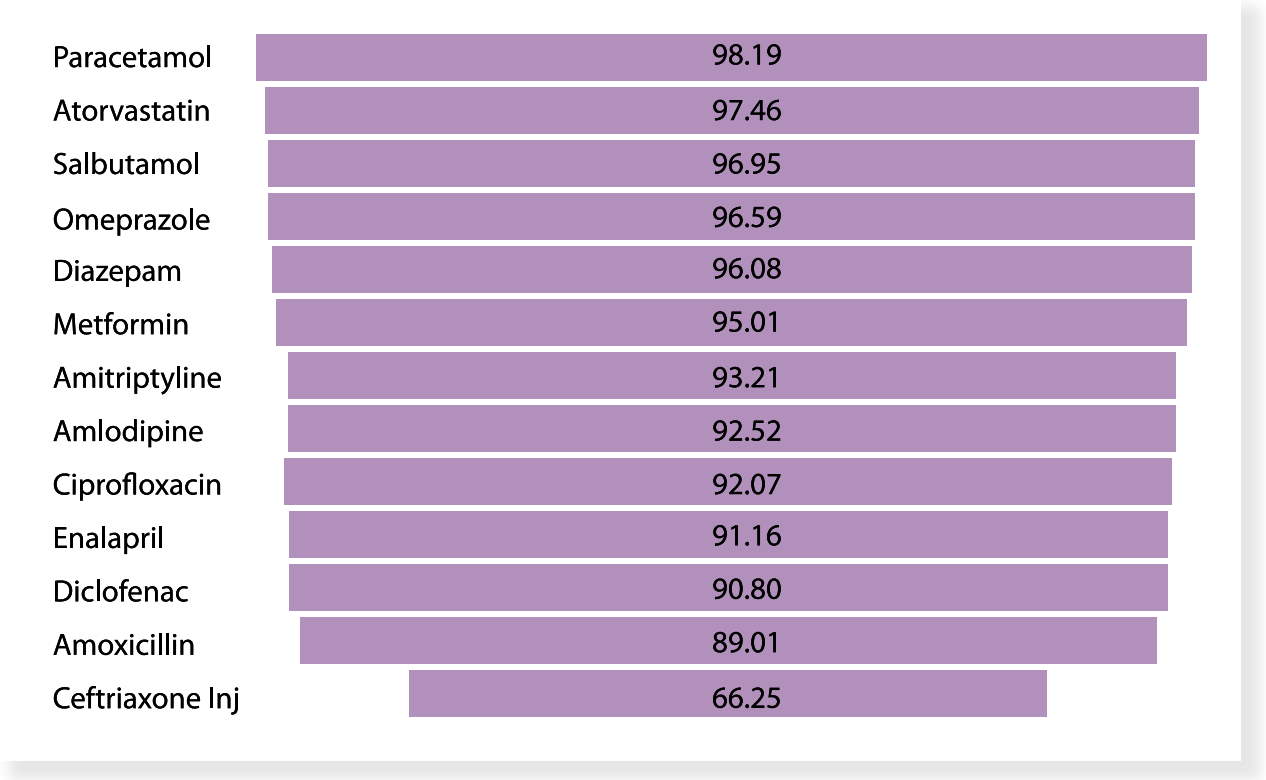


Figure 9: Mean quantity of medicines distributed to sampled HCFs during FY 22-23 (%)

INVENTORY MANAGEMENT

The District Drug Warehouses in the State were of *industrial standard with high storage capacity, specialized equipment* (loading docks, forklifts) *and infrastructure* (walk-in cooler, cold-storage, dedicated floors for medicine categories), and *with adequate safety and security features*. Resultantly, the inventory management at the DDWs is quite robust, with careful maintenance of the medicines. An analysis of the average buffer stock maintained at the facilities towards the end of the year is shown below *(Table 10)*. While buffer stock is relatively maintained throughout the year, the analysis shows that the DDWs had sufficient stock while transitioning to the next financial year. This is also because the procurement cycle is flexible and does not strictly align with the financial year cycle.

Table 11: Mean stock at the DDWs towards the end of the FY 22-23 with respect to average monthly consumption

Districts	In Months
Chennai	1.48
Cuddalore	2.03
Coimbatore	2.28
Krishnagiri	1.52
Namakkal	2.49

Source: DDWs

STOCK MANAGEMENT

Most of the HCFs had adequate infrastructure and space for maintaining stocks at the main store and the sub-stores (i.e. pharmacies). However, there remains scope for improved storage and segregation practices, especially at the AAM.

The accuracy of the stock reported in the records was verified physically for the assessment. The verification could be completed for all 13 tracer medicines in 47 of the 51 facilities. Gaps in record maintenance or traceability of physical stock were observed only in 4 facilities.

Although over 60% of the sampled facilities had an electronic platform for record maintenance, 5% - 37% of those facilities in each district still maintained manual records for stock management. To fulfill the study's requirement, this component utilized data from the digital or manual records, as available at the HCFs. *Table 12* gives a snapshot of the sources used for the sampled facilities.

The stock accuracy to its reporting is shown below *(See Table 12)*. Although the average data indicates a slight excess in reported stock compared to actual physical units, most of this discrepancy stemmed from a lack of real-time data capture mechanisms. As a routine practice, data entry was performed at the end of the day or only on specific days of the week.

Gross discrepancies become apparent through the min-max data of stock accuracy. Lack of space, infrastructural shortfall for organizing stores/sub-stores, concurrent renovation activities, lack of regularly positioned HR for stock management and record maintenance, and excessive case-load or responsibilities affected store/sub-stock management, record keeping activities, which led to gross discrepancies in stock accuracy levels.

Store Rooms

Table 12: Data source for verifying physical stock

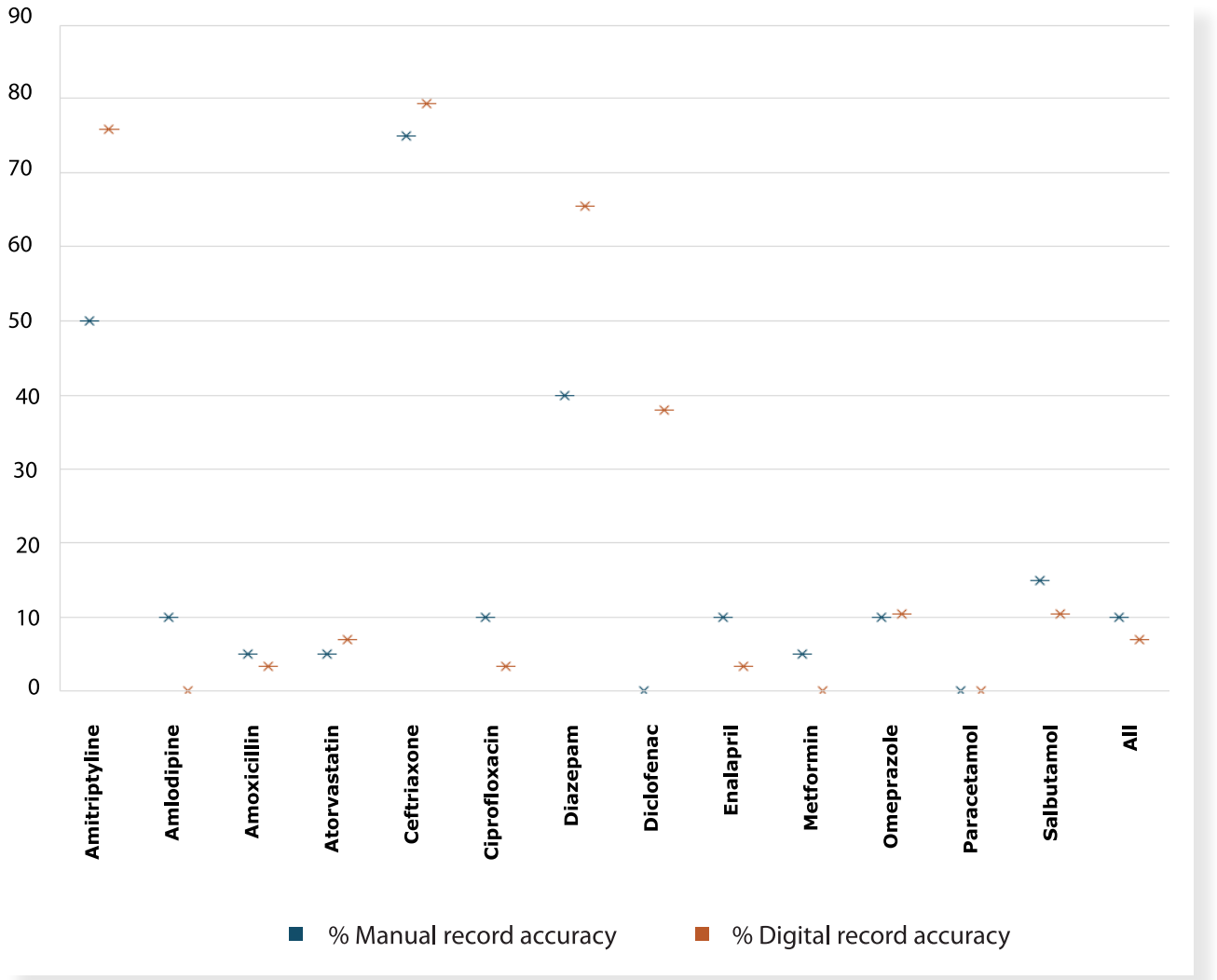
Data Source	Digital	Manual	Total
Availability of functional portals			
DDMS	27	5	32
HMIS	27	15	42
Districts			
Chennai	0	9	9
Coimbatore	4	5	9
Cuddalore	5	3	8
Krishnagiri	6	3	9
Namakkal	7	1	8
Tenkasi	7	1	8
HCFs			
DH	1	4	5
SDH	1	6	7
CHC/BPHC	5	4	9
AAM - PHC	22	8	30
Pooled	**29**	**22**	**51**
Verification complete			
Yes	28	19	47
No	1	3	4

Table 13: Stock accuracy – districts, HCFs, pooled, data sources

Stock Accuracy	Median	IQR	Min	Max
Districts				
Chennai	101.73	12.01	65.31	143.64
Cuddalore	104.45	19.73	78.26	330.75
Krishnagiri	102.04	28.08	78.09	129.69
Coimbatore	101.46	8.37	83.81	249.33
Namakkal	100.34	22.74	76.48	125.21
Tenkasi	109.25	44.32	74.24	152.99
HCFs				
DH	122.74	17.52	104.51	149.52
SDH	103.88	7.30	65.31	117.90

Stock Accuracy	Median	IQR	Min	Max
CHC/BPHC	100.42	16.10	78.09	141.11
AAM - PHC	101.92	18.98	74.24	330.75
Pooled	**102.04**	**22.55**	**65.31**	**330.75**
Data Source				
Manual Registers	101.61	10.89	65.31	143.64
Digital Registers	**102.28**	**28.08**	**74.24**	**330.75**

Figure 10: 100%Accuracy in Reported and Available Stock– Tracer Medicine-wise



Higher stock accuracies were observed in Mental Health Medicines, and Injection vials across facilities. It was reported that the HCFs were directed to avoid overstocking, as it could lead to inefficient stock management, tracking, and wastage. Based on the consumption rate, HCFs with excess and slow-moving medicines are often transferred to HCFs with immediate requirements or fast-moving demand for the same medicine. The inter-facility transfers were facilitated between the HCFs and

were considered an effective way to minimize wastage due to expiry or poor storage. The TNMSC head office coordinates a similar mechanism for Inter-Warehouse Transfers.

As a result, minimal wastage was observed for tracer medicines at both the DDWs and HCFs. During FY 22-23, only two instances of wastage were reported at a DDW: one involving the expiry of Injection Ceftriaxone 1gm vials, and another due to a batch quality failure. No HCFs reported any damage or expiry of tracer medicines during the year. *The transfers across the facilities prevented prolonged stock shortage, excess, or wastage, which is an important SCM flexibility leveraged by the HCFs.*

STOCK AVAILABILITY

The overall goal of the SCM activities is to ensure the availability of essential medicines to the HCFs for an uninterrupted and responsive service delivery. The study assessed the availability of stock on the day of the assessment, during the assessment period (FY 22-23) and the cumulative stock out days.

Stockout Rate on the Day of Assessment

Stockouts of the tracer medicines were most frequently recorded at the AAM, especially in Coimbatore *(See Table 14)*.

Ayushman Arogya Mandir

Table 14: Stockout rate on the day of assessment (%)

Stockout rate	Mean	LSE	95% CI	
Districts				
Chennai	3.35	0.62	2.05	4.66
Cuddalore	2.17	0.83	0.42	3.91
Krishnagiri	3.31	0.52	2.21	4.41
Coimbatore	12.85	5.05	2.20	23.50
Namakkal	0.11	0.14	-0.19*	0.40
Tenkasi	5.30	2.11	0.84	9.75
HCFs				
DH	1.54	1.26	-1.13*	4.20
SDH	0.00	.	.	.
CHC/BPHC	0.31	0.27	-0.27*	0.89
AAM - PHC	6.20	2.24	1.48	10.93
Pooled	**4.74**	**1.79**	**0.97**	**8.52**

** The practical lower bound of the confidence interval should be interpreted as zero. The negative value was generated because a small sample of HCFs reported stockouts on the day of assessment, and the observed stockout rate was close to zero.*

Table 15: Percentage of HCFs reporting stock-out of tracer medicines on the day of assessment

Tracer Medicines	% of HCFs	LSE	95% CI	
Amitriptyline	6.74	4.56	1.54	25.06
Amlodipine	6.97	3.15	2.61	17.28
Amoxicillin	2.34	2.07	0.35	13.93
Atorvastatin	0	.	.	.
Ciprofloxacin	0	.	.	.
Diazepam	10.14	6.8	2.28	35.26
Diclofenac	5.68	3.41	1.54	18.76
Enalapril	0	.	.	.
Inj. Ceftriaxone vial	10.13	6.77	2.29	35.13
Metformin	0	.	.	.
Omeprazole	8.32	4.17	2.78	22.33
Paracetamol	0	.	.	.
Salbutamol	11.33	5.88	3.59	30.51

Stock Availability During the Assessment Period

The study assessed the number of stockout episodes (n) during the assessment period (FY 22-23), and the cumulative days (min-max) without medicines stock – as a proxy for assessing the stock availability *(See Table 16)*.

Table 16: Stockout episodes and cumulative number of days without stock during FY 22-23 – District wise

Districts	Chennai	Cuddalore	Krishnagiri	Coimbatore	Namakkal	Tenkasi
Stockout episodes	**n (days)**	**n (days)**	**n (days)**	**n (days)**	**n (days)**	**n (days)**
Amitriptyline	0	2 (35-111)	0	0	1 (21)	0
Amlodipine	1 (7)	2 (30-214)	0	3 (2-11)	1 (39)	0
Amoxicillin	2 (144-171)	1 (98)	0	1 (80)	1 (4)	1 (21)
Atorvastatin	1 (86)	2 (27-102)	0	1 (57)	1 (8)	0
Ciprofloxacin	2 (34-37)	2 (15-63)	0	0	2 (5-9)	3 (37)
Diazepam	2 (10-28)	1 (60)	0	2 (15-70)	1 (185)	1 (66)
Diclofenac	0	1 (148)	0	1 (6)	2 (22-83)	1 (72)
Enalapril	1 (124)	3 (96-210)	0	1 (41)	1 (30)	0
Inj. Ceftriaxone	1 (102)	2 (85-127)	1 (110)	1 (103)	1(117)	1 (120)
Metformin	1 (3)	2 (23-72)	0	0	0	1 (8)
Omeprazole	1 (2)	2 (19-105)	0	0	3 (7-160)	3 (101)
Paracetamol	0	1 (24)	0	0	0	0
Salbutamol	1 (39)	1 (33)	0	1 (7)	1 (11)	0

Table 17: Stockout episodes and cumulative number of days without stock during FY 22-23 – HCFs

HCFs	DH	SDH	CHC	AAM	Pooled	Tenkasi
Stockout episodes	n (days)	n (days)	n (days)	n (days)	n (days)	n (days)
Amitriptyline	0	0	1 (35)	2 (21-111)	3 (21-111)	0
Amlodipine	0	1 (3)	1 (214)	5 (39)	7 (3-214)	0
Amoxicillin	1 (4)	0	1 (98)	5 (21-171)	7 (4-171)	1 (21)
Atorvastatin	0	0	3 (8-102)	3 (86)	6 (8-102)	0
Ciprofloxacin	2 (5-15)	1 (37)	2 (63)	1(37)	11 (5-63)	3 (37)

HCFs	DH	SDH	CHC	AAM	Pooled	Tenkasi
Diazepam	1 (15)	2 (10-70)	1 (60)	3 (28-185)	7 (10-185)	1 (66)
Diclofenac	1 (22)	0	1 (148)	3 (6-83)	5 (6-148)	1 (72)
Enalapril	1 (30)	1 (41)	1 (96)	4 (210)	7 (30-210)	0
Inj. Ceftriaxone	1 (127)	3 (85)	1 (100)	2 (117-120)	7 (85-127)	1 (120)
Metformin	0	0	1 (72)	4 (23)	5 (23-72)	1 (8)
Omeprazole	1 (7)	1 (18)	1 (105)	6 (160)	9 (7-160)	3 (101)
Paracetamol	0	0	1 (24)	0	1 (24)	0
Salbutamol	1 (11)	0	0	4 (39)	5 (11-39)	0

The identification of stockout episodes and cumulative days without stock was only possible in facilities with robust record maintenance (store and sub-stock records). There were many reasons for non-availability of medicines during the assessment period:

- Non-availability at the DDWs contributed to prolonged stock-out periods.
- Turnover of healthcare providers (MOs/ Specialists) affected consumption patterns, as provider preferences led to a mismatch between indent practices and consumption patterns.
- When financial allocation for general medicines was insufficient to indent medicines according to actual demand, HCFs tended to prioritize cheaper alternatives of essential medicines. This resulted in the non-availability of some tracer medicines, as their substitutes were procured.
- Upgraded HCFs sometimes experienced delays in receiving additional passbook vouchers. For example, an AAM upgraded to an SDH did not receive a separate passbook for NCD medicines. As a result, during FY 22-23, the facility purchased NCD medicines from its unrevised passbook for general medicines, which constrained the quantity of other essential medicines.
- The stock of psychiatric medicines was closely tied to the availability of mental health services (e.g. psychiatric OPD), availability of medical officers at the facility as well as the case-load of patients seeking mental health services at the facility.

MEDICINE AVAILABILITY FOR THE END-USERS

During the assessment, interactions were held with the users of HCFs to understand how well the medicine supplies met the patients' needs.

Respondent Characteristics

Table 18: Respondent Characteristics – End-users

No. of Respondents		Presenting Conditions at HCFs*					Respondents with >1 preseating condition	Services availed	
		MNN	CD/ ID	NCD	Injuries	Others	Multiple conditions	Consultation & medicines	Only medicines
Districts	**N (%)**						**N=24**	**N = 227**	**N = 42**
Chennai	53 (19.7)	7.55	35.85	35.85	3.77	16.98	16.98	75.47	24.53
Coimbatore	41 (15.61)	2.38	35.71	50	9.52	2.38	11.9	78.57	21.43
Cuddalore	42 (16.73)	4.44	35.56	46.67	13.33	0	6.67	75.56	24.44
Krishnagiri	45 (15.24)	2.44	39.02	53.66	4.88	0	4.88	95.12	4.88
Namakkal	46 (17.1)	0	47.83	43.48	4.35	4.35	6.52	91.3	8.7
Tenkasi	42 (15.61)	0	52.38	19.05	9.52	19.05	4.76	92.86	7.14
HCFs									
DH	31 (11.52)	0	45.16	32.26	3.23	19.35	9.68	96.77	3.23
SDH	43 (15.99)	0	72.09	25.58	2.33	0	4.65	100	0
CHC/BPHC	56 (20.82)	3.57	41.07	39.29	10.71	5.36	10.71	94.64	5.36
AAM - PHC	139 (51.67)	4.32	30.22	48.92	8.63	7.91	9.35	72.66	27.34
Total (N)	**269**	**2.97**	**40.89**	**41.26**	**7.43**	**7.43**	**8.92**	**84.39**	**15.61**

**MNN – Maternal, Neonatal and Nutrition; CD/ID – Communicable/Infectious Disease; NCD – Non-Communicable Diseases*

Most OPD users who participated in exit interviews reported accessing HCFs for minor ailments (communicable/infectious diseases) and NCDs. The group that accessed the facilities solely for medicines was primarily comprised of users empaneled with the facilities for monthly follow-ups or those referred to the facilities for prescription fulfillment. Some of these users only accessed the pharmacies to obtain vitamin supplements without prescriptions.

Users

Availability of Medicines on the Day of the Visit

The users' prescription slips were scrutinized during interactions to record the number and quantity of medicine items prescribed and dispensed to the users. Table 19 shows the prescription fulfilled by the HCFs on the day of assessment. Only 2 respondents reported not having received any medicines. Major reasons for incomplete or nil prescription fulfillment have been shown in *Table 20*.

Table 19: Mean percentage of medicines received as prescribed to the users (%)

	Mean	SE	95% CI	
Presenting Conditions				
MNN	100.00	0.00	.	.
CD/ID	97.74	1.10	95.58	99.91
NCD	98.74	0.68	97.40	100.07
Injuries	98.75	1.25	96.29	101.21
Others	100.00	0.00	.	.
Districts				
Chennai	96.64	1.54	93.60	99.67
Cuddalore	99.52	0.48	98.59	100.46
Krishnagiri	97.89	1.30	95.34	100.44
Coimbatore	97.56	2.44	92.76	102.36
Namakkal	99.57	0.43	98.71	100.42
Tenkasi	100	0	.	.

	Mean	SE	95% CI	
HCFs				
DH	99.35	0.65	98.08	100.63
SDH	100.00	0.00	.	.
CHC/BPHC	96.96	1.55	93.92	100.01
AAM - PHC	98.39	0.82	96.78	100.00
Pooled	**98.46**	**0.54**	**97.41**	**99.52**

Table 20: Reasons for nil or incomplete prescription fulfilment (%)

Reasons	Not in stock	Outside EDL	Shortfall
Districts			
Chennai	66.67	16.67	16.67
Cuddalore	100	0	0
Krishnagiri	100	0	0
Coimbatore	100	0	0
Namakkal	0	100	0
Tenkasi	0	0	0
HCFs			
DH	100	0	0
SDH	0	0	0
CHC/BPHC	66.67	33.33	0
AAM-PHC	75	12.5	12.5
Pooled	**75**	**16.67**	**8.33**

Observational Findings

Though the study could record only two instances of partial fulfillment of medicine items, the practice was relatively pervasive. It was evident through observations of pharmacy operations, and general scrutiny of prescription slips.

Prescription practices in the State need serious attention. Due to the non-availability of prescription slips, the doctors had no choice but to use paper chits to write shorthand prescriptions. They were retained back by the pharmacists for tallying the consumption records. Exception to this practice was observed among the NCD patients, who were asked to maintain a notebook that recorded and updated the medicines prescribed during each visit.

At the pharmacies, the medicines were handed out loosely, and not in individual covers/envelopes with written instructions. It was not possible to differentiate

Medicine availability

medicines with similar packaging. In some instances, the pharmacists hesitated to inform the users if any medicine item was unavailable, or if the medicines were provided only partially. These were done either to avert conflicts or to rationalize distribution. This practice was supported by the MOs who deliberately prescribed for a shorter duration. Most of the facilities focused on providing 'some medicines' rather than 'no medicine' as a response to the community's sentiments.

Contractually posted medical officers more often prescribed branded medicines and medicines outside the EML than the regular MOs, *reflecting a major orientation gap during HRH onboarding*. The pharmacists in most of the HCFs reportedly appraised the stock availability status to the prescribing physicians through WhatsApp platform to support prescription decisions. However, the communication gap between the MOs and pharmacists was evident in some HCFs as the prescriptions did not align with the stock available at the facilities. During these instances, the pharmacist resorted to dispensing the substitute medicines or requested the users to purchase locally.

NCD patients accessing CHCs, SDHs, and DHs were mobilized to the AAM in their locality for follow-up and prescription fulfillment. While this approach is expected to gradually strengthen gatekeeping, the lack of prescription fulfillment at the AAM threatens disengagement with public HCFs and fosters dissatisfaction.

The goal of SCM for medicines is achieved when medicines are delivered to the right place, at the right time, and in the right quantity. While this is noticeably ensured at the level of TNMSC functionaries, it has been observed to be compromised at the point of service delivery. Deliberate modification of prescriptions by doctors and dispensing practices by pharmacists/in-charge to rationalize stock availability suggests an inadequacy in the quantity of medicines provided to the HCFs against their actual demand. There is a possibility that data on forecasted/estimated consumption could be reconciled with the actual demand when prescription practices are streamlined.

Availability of Medicines During the Last Visit to the HCFs

223 out of the 269 respondents accessed the same HCFs within the last 6 months from the time of the survey. During their last visit, most of them reportedly received all medicines as prescribed *(Table 21)*.

Table 21: Report of prescription fulfillment during the last visit (%)

Prescription Fulfilment	Not fulfilled	Partially fulfilled	Completely fulfilled
Districts			
Chennai (n=40; 75.47%)	0	9.43	90.57
Cuddalore (n=35; 83.33%)	0	2.38	97.62
Krishnagiri (n=34; 75.56%)	2.22	4.44	93.33
Coimbatore (n=39; 95.12%)	2.44	0	97.56
Namakkal (n=40; 86.96%)	0	2.17	97.83
Tenkasi (n=35; 83.33%)	0	0	100
HCFs			
DH (n=23; 74.19%)	0	3.23	96.77
SDH (n=38; 88.37%)	0	0.00	100.00
CHC/BPHC (n= 41; 73.21%)	0	5.36	94.64
AAM -PHC (n=121; 87.05%)	1.44	3.60	94.96
Pooled	**0.74**	**3.35**	**95.91**

Satisfaction with Quality

Users who have availed medicines from the HCFs were asked if they found the quality of medicines dispensed to them to be satisfactory. From the users' perspectives, quality encompassed various aspects, centered around *fulfilling their expectations*. Users perceived quality in terms of '*quick relief*' from ailments or pain when medications were administered; '*adequate control of ailments*' like Diabetes and Hypertension; '*prescription fulfillment*'; '*receiving written instructions for the medicines*'; and '*availability of medicines and doctors*' (thus avoiding additional trips to other

hospitals or pharmacies). Consequently, patients expressed dissatisfaction when these needs were unmet *(See Table 22)*.

One respondent highlighted receiving '*damp tablets*', indicating gaps in packaging and storage. Not all patients accepted alternative or substitute medications, especially when they were aware of what had been prescribed for their ailment, such as receiving tablets for oral administration instead of a topical ointment for a dermatological condition. A common concern raised by the users was the lack of medicines providing adequate pain control for musculoskeletal conditions. Some respondents preferred purchasing NCD medicines for Diabetes, Cholesterol, and Musculoskeletal pain from private providers as they experienced better control and management of their conditions. Providers explained that some NCD patients did not adhere to the pharmaceutical regimen once they achieved substantial control, and would restart the regimen once symptoms worsened. This feedback calls for strengthening the quality of NCD consultation and counselling services to improve patient knowledge and disease management practices. *From a supply chain perspective, HCFs need to provide written instructions to all patients, especially those on put on a long-term pharmaceutical regimen.*

Table 22: User responses (%) – Satisfaction towards quality of medicines

User Response	Satisfied	Not Satisfied	Other responses
Districts			
Chennai	97.5	0	3
Cuddalore	82.86	5.71	11.73
Krishnagiri	94.12	0	5.88
Coimbatore	100	0	0.00
Namakkal	97.5	0	2.50
Tenkasi	97.14	0	2.86
HCFs			
DH	95.65	0.00	4.35
SDH	97.37	0.00	2.63
CHC/BPHC	92.68	2.44	4.88
AAM-PHC	95.04	0.83	4.13
Pooled	**95.07**	**0.9**	**4.04**

Overall, the HCFs were able to substantially cater to patient needs. Identified implementation gaps may be strengthened to enhance the health system's responsiveness and improve the population health outcomes.

ENABLERS AND BARRIERS

The SCM system in the State through a dedicated Medical Service Corporation Limited is one of the matured systems in the country. The practices followed by TNMSC could guide improvements in health system efficiency and effectiveness in service delivery. Nevertheless, the existing system could be strengthened in a few areas to enhance its overall efficiency.

Key Enablers of the SCM System

- The *State annually updates the State specific EML* by integrating the feedback of representatives across the level of care. Through this annual exercise, the State's SCM system attempts to reconcile its resources for healthcare delivery with the reported population-level needs.
- Integration of the ICT platform since the inception of the Medical Service Corporation has provided a significant advantage by creating a *robust database for generating analytical insights on key SCM functions*. In-house management of the software with routine updates and troubleshoot support has *allowed the ICT platform to evolve with the organizational demands*.
- The design of the ICT platform aids transparency in operations and enforces accountability among the internal and external stakeholders of the SCM system. It has *substantially mitigated manual computing and decision-making for end-to-end processes*.
- *Quality control and assurance have been in-built in the governance framework of the SCM system*. The State's Medical Service Corporation has developed a Procurement and Quality Assurance Manual to uniformly implement the coordinated activities. Strict adherence to standardized protocols has been routinized to enforce both performance and quality standards among the stakeholders. Further, the *DDMS serves to minimize human interference and potential biases in business*, thereby increasing transparency.
- The practice of global tendering and the empanelment of a pool of suppliers for every item at all times *safeguard the public health system from supply chain shocks* due to external factors (supplier failure, natural disasters, epidemic outbreaks, etc.)
- Some of the key supply chain activities such as analytical testing and logistics management have been strategically outsourced to external entities.
- Volume based procurement at the TNMSC, combined with value-based indenting at the HCFs, appear to be cost saving, and necessary for mitigating the wastage of limited resources. Value-based indenting does not necessarily hinder demand responsiveness at the HCFs as their respective Directorates support the district-level functionaries to meet demand by providing additional medicines to the HCFs.
- *Clear role definitions and functional boundaries* between the TNMSC head-office, DDWs, and HCFs *in the SCM activities prevented duplication of activities and*

resources. The utility of the DDMS portal has been adjusted to accommodate the level of SCM activities expected from each stakeholder.

- *State's SCM system is more dynamic and responsive* since it's not having a rigid linkage of its medicine procurement cycle to the financial year cycle. The use of *dynamic forecasts* to implement a *rolling procurement plan*, buffer stocks and safety levels *ensure adequate inventory* at the DDWs and stock at the HCFs *throughout each financial year cycles*.
- Adequate investments have been made at the level of DDWs to support efficient inventory management and minimize wastage of units. The practice of inter-warehouse transfers by the TNMSC allows the appropriation of stock units between DDWs for managing immediate requirements and expediting the consumption of near-expiry drugs. Similarly, guidance provided to the HCFs on stock management with strategies to reduce over-stocking, or meet immediate requirement have a relatively streamlined supply chain network between the facilities of a district.
- Distribution channels through direct indenting, district-level functionaries and inter-facility transfers enable facilities to receive within, and at times beyond the passbook value allotment. *This extended provision effectively minimized local procurement*. Additionally, permission to procure locally only after receiving NOCs from the DDWs *disincentivized resource diversion into avertable local procurement*.
- The *ability to retain the State cadre pharmacists* in the public health system has *greatly supported the streamlining of the SCM system's operations*. Most of the senior level pharmacists have been part of the public health system since the inception of TNMSC and have been functioning with a thorough understanding of job roles and responsibilities.
- The infrastructural investments at the facilities are currently adequate for the predominant paper-based system.
- The internship opportunities for the student pharmacists at the DDWs and the main stores of secondary HCFs are *good capacity building practices*, especially when the interns later choose to serve in the public health system.

Areas Needing Attention

The SCM system is robust enough to cater to the healthcare needs of the patients using public healthcare facilities. While the operations of TNMSC focus on key SCM functions at the central level, SCM activities at the district level may be strengthened further.

- The SCM system in the HCFs is predominantly manual. The implementation of digital platforms was variable with limited utility at the HCFs. *The need and the expected outcomes in introducing ICT platforms have not been well defined*. Currently, the HCFs have been mandated to maintain digital and manual records. This has increased the work-load of the pharmacists. Additionally, the lack of reliable internet connectivity, server hang-ups, and lack of data aggregation at

the portal reinforce *resistance to digitalization, especially among the senior pharmacists*. In these instances, manual record-keeping was considered to be more reliable for retrieving information and computation.

- *HRH shortfall was a major concern across the districts*. Regular pharmacists have been assigned responsibilities for medicine indent and receipt, and were accountable for data entry at the portal and stock management. Practices like HRH rationalization or deputation could, at best, keep the pharmacies operational, whereas, stock management and record maintenance suffered.
- HRH training gaps were identified for utilizing the portal. There was *an evident mismatch between training activities and the skill gaps*.
- SCM activity such as estimating consumption/requirement was *not documented from the HCFs* for analyzing forecast accuracy.
- *Logistics management practices need attention and scrutiny*. The TNMSC reported levying 5% as service charge for the medicines' logistics management. However, none of the sampled DDWs outside Chennai reported facilitating transport arrangement for distribution. The HCFs had to arrange pick-up vehicles, and were reimbursed for fuel only if they used government owned transport vehicles other than MMUs. In the event of vehicle non-availability, the facilities could not show-up at the DDWs as per their allotted dates for receiving supplies. By accommodating these uncertainties, the DDW personnel too experienced an added work load. Further, the pick-up vehicle's capacity affected the quantity of medicines collected during each trip to the DDWs, resulting in multiple visits and additional costs. At times, the pharmacists incurred personal expenses while arranging transportation, with delayed reimbursement.
- *Prescription practices at the HCFs were highly variable and needed immediate attention*. Doctors were forced to write shorthand prescriptions due to the non-availability of standardized prescription slips or paper forms. Branded medicines and medicines outside the EML were prescribed mostly by contractually hired or posted doctors. Prescription practices at times did not align with the actual stock at the HCF, resulting in the issuance of alternatives/substitutes or local purchases for the users. *The practice of conducting prescription audits needs to be streamlined*.
- *Dispensing practices at the HCFs also need attention*. The prescription chits were usually retained by the pharmacists for tallying daily consumption records. *Medicines were handed out loose, without a cover or written instructions*. Verbal instructions were alone provided, and at times information on partial non-fulfillment was not communicated to the users to avert conflicts. The HCFs primarily focused on providing services at scale, even if it meant not dispensing medicines for the recommended dosage and duration. The MOs supported this practice, taking into account the community's sentiments. However, in the context of patient safety, these practices need to be rectified.

KERALA

STATE CONTEXT

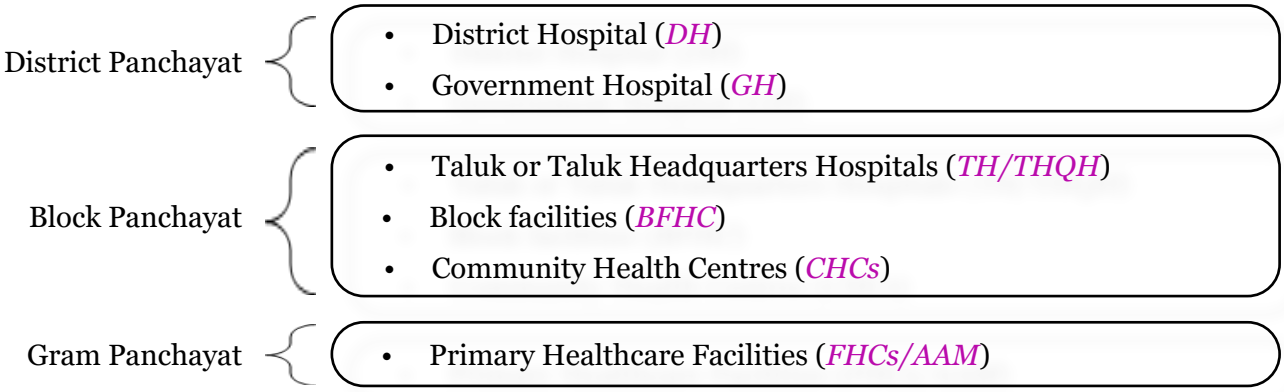
While it is known that Kerala's SCM model was primarily inspired by Tamil Nadu's, the structural and operational nuances that make Kerala's SCM system distinct from other States become more apparent when analyzed within its unique context.

Kerala's Department of Health and Family Welfare (*DHFW*) has two independent directorates overseeing public healthcare facilities (*HCFs*) under *modern medicine*. The Directorate of Health Services (*DHS*) is the administrative authority of the primary and secondary level HCFs, and the Directorate of Medical Education (*DME*) is for the tertiary level institutions. Each directorate has its district level functionary. The Health and Family Welfare Society (*SH&FWS*) implement State (*National*) Health Mission (*SHM*) activities with the help of its district counterpart (*DH&FWS*). The State Health Systems Resource Centre (*SHSRC*) serves as the apex body for technical support to the health department.

In 2017, the Government of Kerala launched the Aardram Mission under the Nava Kerala Mission.[27,28] This initiative aimed to implement a series of infrastructural and administrative reforms, transforming Primary Health Centres *(PHCs*) into Family Health Centres (*FHCs*). The mission focused on enhancing universal access to comprehensive, patient-centered health services while ensuring the standardization of care across all service levels.

Apart from the DHFW, *Kerala's Local Self Government Department* (*LSGD*) *plays a vital role in the public health system* by supporting the operations of HCFs under their jurisdiction (See Figure 11). For instance, LSGDs are specifically tasked with ensuring the efficient functioning and management of their respective FHCs by providing infrastructure, human resources, logistical support, and supervision.[29,30] Furthermore, the LSGD's strong presence in the health sector has *fostered robust interlinkages with other social development sectors*, including Social Justice, Education, Agriculture, Water Supply, and SC/ST Development., as health is considered the focal point of all developmental activities undertaken by the LSGD.

Figure 11: HCFs under each level of LSGD



The Kerala Medical Service Corporation (*KMSCL*), established in 2007, is a government-owned company that supports all healthcare institutions under the DHFW. Modeled after TNMSC, KMSCL serves as the single nodal agency responsible for the procurement and distribution of medicines and medical products for entities such as the DHS, NHM, Social Justice Department, Kerala AIDS Control Society, Regional Cancer Centre, and Employees State Insurance Corporation.

KMSCL operates through dedicated divisions that handle medicine procurement, equipment acquisition, supply chain management, quality control, State-specific projects, Karunya Community Pharmacies, ambulance services, and administrative functions. Additionally, it is authorized to provide HCFs with essential infrastructural support, including medicines, diagnostic services, and more.

The Board of KMSCL comprises the Principal Secretary – Health and Family Welfare, the Mission Director (NHM), the Managing Director – KMSCL, the Additional Secretary – Finance Department, the Director of Health Services, the Director of Medical Education, the Head of the Department of Pharmaceutical Sciences, and the Drug Controller. *KMSCL reportedly levies up to 7% of the total procurement cost as service charges to sustain its operations, making it a self-sustaining entity*. Procurement funding is sourced from the State's provincial non-planned funds for the Essential Drug List (EDL), the NHM, World Bank Projects, and the 15th Finance Commission's health sector grant.

In response to the limited availability of medicines at public HCFs during the early 1990s, the State introduced the concept of Community Pharmacies (pay counters) in major hospitals. These pharmacies allowed patients to purchase otherwise unavailable medicines at subsidized prices. The management of these pharmacies was carried out collaboratively by the Hospital Development Committee (HDC) and the hospital pharmacies.[31] In 2012, the Karunya Community Pharmacy (*KCP*) Scheme was launched under KMSCL and quickly established itself as a significant player in the State's pharmaceutical sector. A dedicated division within KMSCL now manages the operations of approximately 74 KCPs and 6 Karunya Medicine Depots across the State. These pharmacies are accessible to the public, offering branded medicines at subsidized prices, ranging from 10% to 93% of the MRP. Additionally, public HCFs are directed to prioritize these pharmacies for local or scheme-based

purchases, including medicines and essential medical devices such as glucometers and strips, which are distributed free of cost to beneficiaries.

The operations of KMSCL are primarily driven by an ICT platform known as the Drugs Distribution Management System (*DDMS*). The online version of DDMS, introduced around FY 2013–14 and streamlined by 2016–17, was implemented following DHFW's decision to automate pharmacy activities across government health institutions. The State's DDMS portal connects KMSCL, State and District Supervisory officers, District Drug Warehouses (*DDWs*), and HCFs in a seamless continuum.

The primary objective of developing this software as a unified application was to track all drug management activities—from procurement to distribution—while enhancing business operations, preventing shortages, reducing losses due to drug expiry, and improving responsiveness to end-user needs. To achieve these goals, the State has directed the heads of HCFs and drug store custodians to employ the software for every SCM activity. Additionally, KMSCL has been tasked with ensuring data security and providing comprehensive training to all end-users.[32] KMSCL's IT wing regularly updates the platform and resolves technical issues to ensure smooth functionality. Notifications regarding software updates are communicated directly through the software interface. Additionally, the DDMS is integrated with the Government of India's *DVDMS* portal, enabling seamless coordination and data exchange.

As part of the *State's Digital Health Mission*, the DHFW has initiated a phased rollout of the *e-Health Project* across modern medicine and AYUSH hospitals and clinics. This initiative, implemented under DHS and DME, is being carried out with support from the *Department of Electronics and Information Technology* (DEITY), Government of India.[33] The project encompasses both non-clinical and clinical components. The non-clinical component aims to establish a comprehensive health database for all citizens in the State, leveraging each individual's *Universal Health Identity* (UHID), which is linked to their *Ayushman Bharat Health Account* (ABHA) ID. The clinical module focuses on streamlining and automating hospital processes, covering the entire patient journey from registration to discharge through a robust end-to-end information management system. This data is integrated into the health database as Electronic Medical Records (EMRs), enabling care continuity and seamless access to patient health information across the public healthcare ecosystem. The centralized database is designed to support surveillance activities, improve disease management, and facilitate informed decision-making by providing users with analytical insights and detailed reports.

The eHealth project is hosted at the State Data Centre (SDC) and connects HCFs through the Kerala State Wide Area Network (KSWAN), which employs Multiprotocol Label Switching Virtual Private Network (MPLS VPN) technology. This ensures secure and reliable private connections over shared network infrastructure. The Government of India's National Optical Fiber Network (now BharatNet), aimed at providing broadband connectivity to Gram Panchayats, has been integrated into this framework.

The project builds on the existing IT initiatives by the DHS and DME, which

have provided IT infrastructure—such as desktops, internet access, and handheld devices—and trained health staff in using digital platforms, extending support down to the primary care level. Implemented in a phased manner, the project is gradually saturating targeted HCFs across districts. By December 2024, the project was operational in 667 institutions, with 31% of them utilizing the platform for e-prescription generation. [34] Wherever possible, the study relied on data from the pharmacy module of the eHealth Project.

INFRASTRUCTURE

Hardware

The study investigated the availability, functionality, and exclusivity of essential infrastructure required for the SCM of medicines at HCFs. *Figures 12 and 13* provide an overview of the infrastructure's general availability, functional status, and dedicated use for SCM activities across various facilities. It was noted that while suitable infrastructure for SCM was present, its utilization was not always integral to the State's SCM model. Furthermore, the exclusivity of infrastructure for SCM purposes varied depending on the requirements at different levels of care.

Figure 12: Infrastructure Status (%) - Hardware; Facility-type aggregate

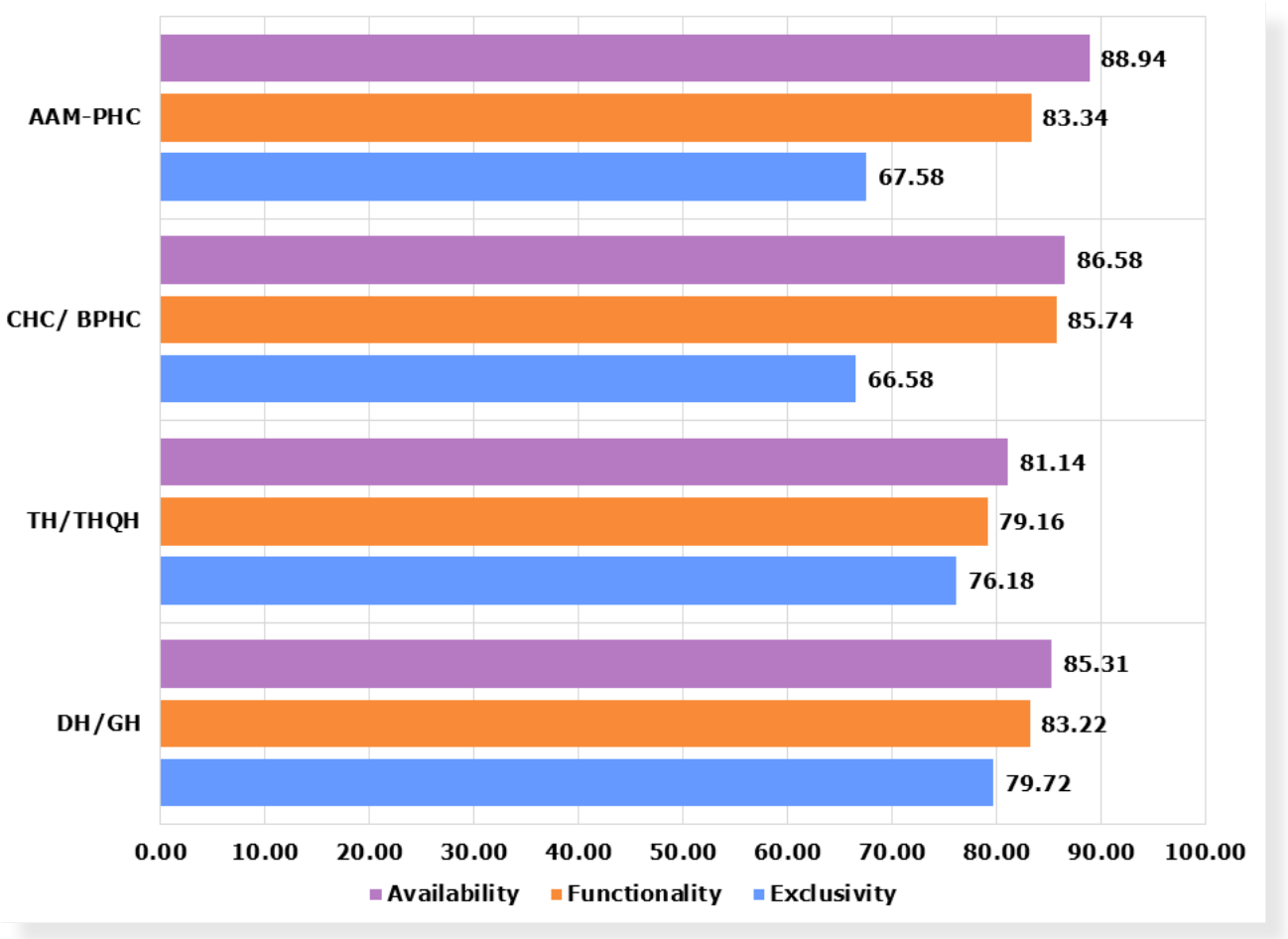
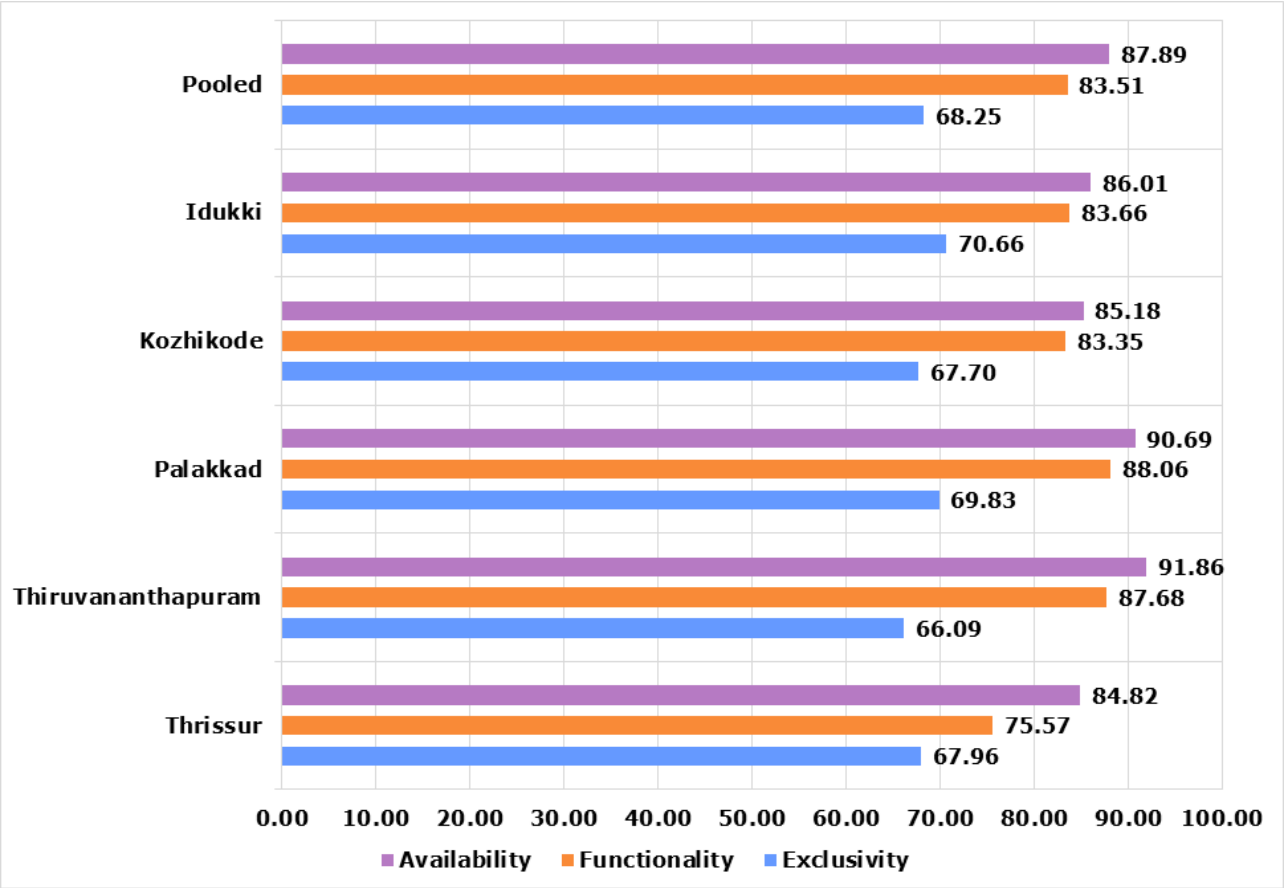


Figure 13: Infrastructure Status (%) – Hardware; District aggregate



All facilities were equipped with adequate and functional infrastructure to support IT-enabled SCM. This included desktop and handheld devices, internet connectivity, printers, scanners, barcode readers, dedicated storage spaces for medicines, and equipment for regulating and monitoring storage temperatures."

Dedicated infrastructure and Stock management

During the rollout of the online version of DDMS, KMSCL was required to provide desktops. In facilities where the e-Health program has been implemented, additional desktops were supplied by the State government. Some facilities also replaced non-functional desktops using LSGD funds. Handheld devices were distributed to frontline workers (JPHN, JHI, or LHI) to support their tasks, including data entry on the eVIN or FPLMIS platforms. *Most facilities had access to government or government-funded internet connections*, which were further enhanced with the implementation of the e-Health project. Additionally, *facilities equipped with e-Health systems installed barcode readers for scanning OP tickets or UHIDs across clinical departments, including Pharmacy*.

Modular pharmacy and Dedicated infrastructure

The State has been leading the *modernization of pharmacies* under an earmarked budget from the Annual Plan Fund. Modular pharmacies are being installed in HCFs across various levels of care in a phased manner to improve storage and stock management. These modular pharmacies facilitate proper segregation and labeling of medicines in pull-out storage bins. For HCFs without modular pharmacies, organizer racks have been provided, serving a similar purpose.

Store room

As part of the same initiative, the State has introduced *infrastructure for temperature control*, including air conditioners for storerooms, refrigerators, ice-lined refrigerators, deep freezers, and temperature monitors to maintain a conducive storage environment despite the tropical monsoon climate.

Additionally, most facilities have some form of power backup for their main storerooms. However, attention is required for facilities in regions with frequent and prolonged power outages, such as Palakkad.

Field Observations

Most HCFs had notably upgraded infrastructure, featuring modernized pharmacies. While all facilities had dedicated rooms for pharmacies and main storerooms to manage stock, *spatial constraints were commonly observed in primary HCFs*. Additionally, some secondary-level facilities faced shortages of storage equipment, such as racks or shelves. The issue of space constraints was particularly pronounced in AAM-PHCs and CHCs during the receipt of supplies from KMSCL.

Spatial Constraints

With the increasing influx of medicines and supplies, along with the retention of dead stock over the years, *infrastructural constraints have created an unfavorable environment for both personnel and stock management* in some facilities. For example, pharmacists at a block FHC in Thiruvananthapuram reported developing occupational health issues, which led to absenteeism and inadvertently shifted their workload onto colleagues.



Spatial Constraints

In one of the visited THQHs undergoing civil renovation, interim measures for storing medicines and operating the pharmacy were implemented. These included converting three inpatient wards into storerooms and repurposing an immunization unit as a pharmacy. However, the storerooms were affected by damp walls due to rain, compromising storage efficiency. The temporary pharmacy also had limited space, making it difficult for pharmacists to move around. The interim arrangements had broader impacts, such as reducing overall bed occupancy during the two-year renovation period, increasing patient waiting times at the pharmacy, and leading to frequent disputes between patients and pharmacists. Post-renovation, the spaces designated for drug stores and the pharmacy were visibly insufficient and unlikely to effectively streamline workflow.

Overall, the layout and spatial capacity of pharmacies, main storerooms, their locations, and available storage infrastructure need to be reevaluated, considering the significant growth in patient footfall and demand since the upgrades.

The introduction of *bar-coded OP tickets, UHIDs, and prescription sheets* in HCFs equipped with the e-Health platform is a promising initiative. Using unique barcodes to access prescription data enables pharmacists to accurately dispense medicines to each patient, eliminating mix-ups even during high case-loads. This system also demonstrates the potential to facilitate continuity of care for patients accessing hospitals across the referral chain. With universal implementation across HCFs, the State's SCM would be strengthened at the point of delivery to end-users.

e-Health counter

However, the availability and display of Standard

Operating Protocols (SoPs) at pharmacies and main storerooms varied significantly. Given the adequacy of infrastructure to support effective SCM, facilities would benefit from establishing and prominently displaying SoPs for the management of medicines.

UHID

Software

The study evaluated the accessibility and functionality of ICT platforms supporting SCM activities in HCFs. These platforms included *DDMS*, the Health Management Information System (*HMIS*), *e-Health*, the Electronic Vaccine Intelligence Network (*eVIN*), and the Family Planning Logistics Management Information System (*FPLMIS*). Additionally, HCFs utilized the *Nikshay portal*, *UWIN*, and *Google Forms* for reporting program-specific medicines and vaccines, as instructed by State or district authorities.

Of these, DDMS, eVIN, and FPLMIS were specifically dedicated to the SCM of medicines, vaccines, and family planning products, respectively. All facilities consistently reported stock-out rates and the total number of essential medicines through the HMIS portal.

Figures 14 and 15 illustrate the access to, functionality, and exclusivity of the portals for the SCM of medicines for each facility type and in the visited districts.

Figure 14: Infrastructure Status (%)- Software: Facility-type aggregate

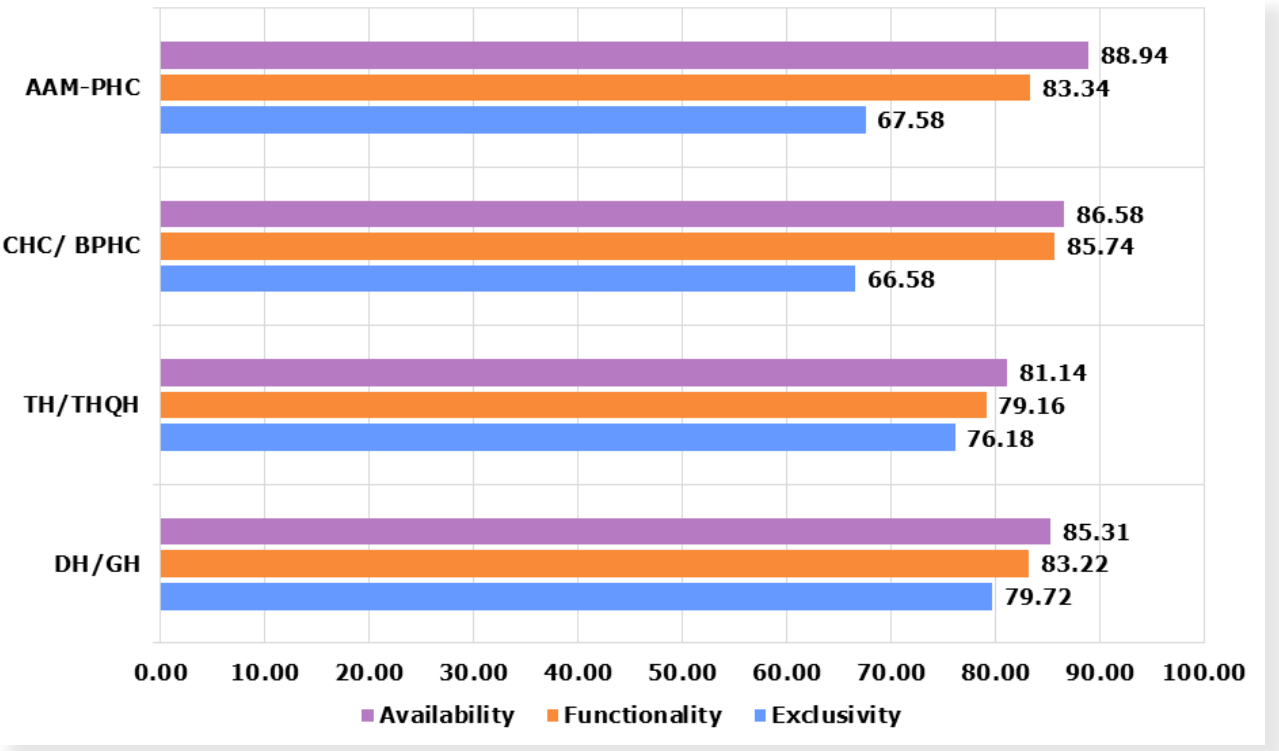
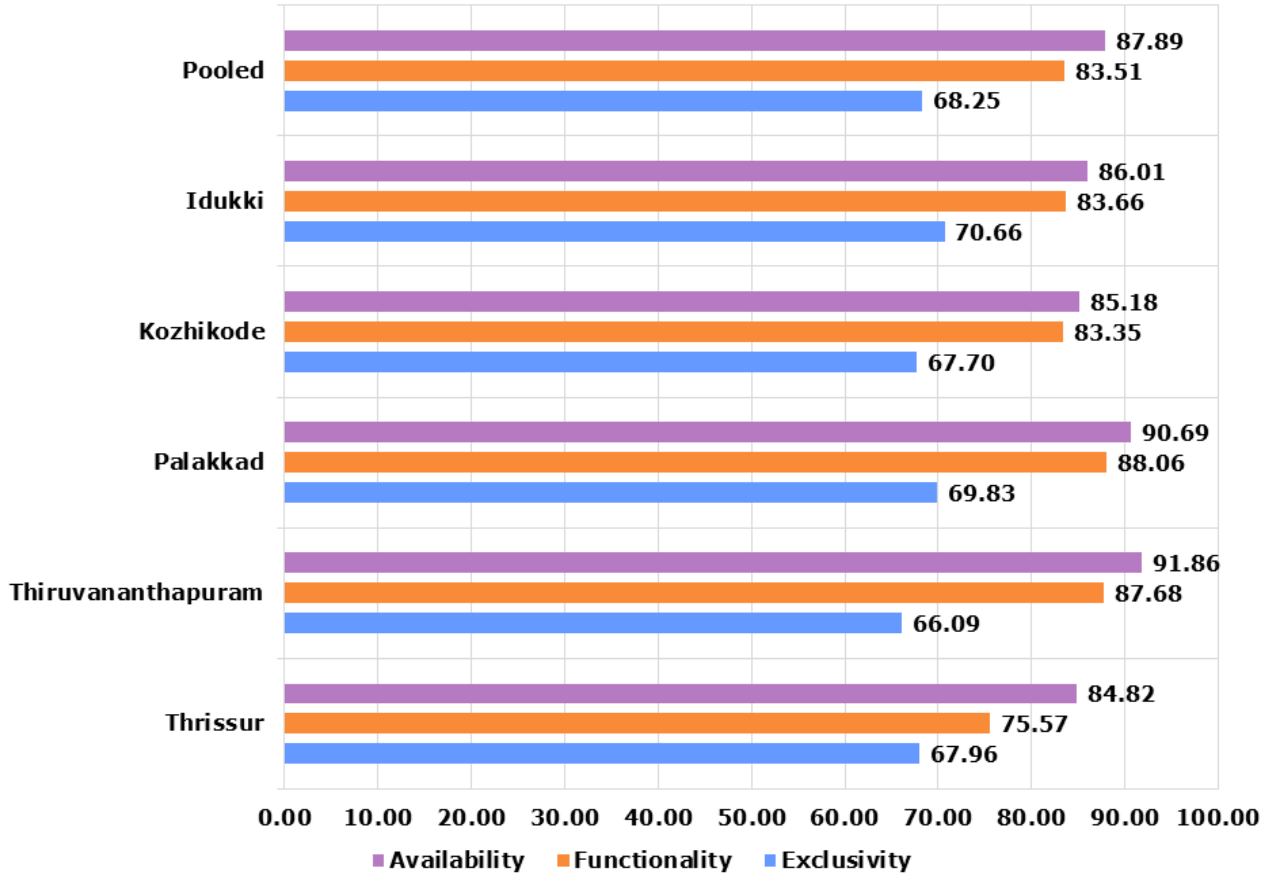
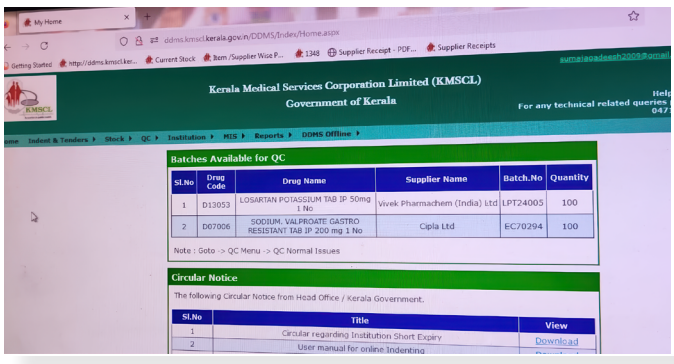


Figure 15: Infrastructure Status (%)- Software; District aggregate



All the visited facilities exclusively utilized DDMS for SCM activities, *reflecting the platform's universal adoption across the State*. Access to DDMS is granted to the hospital's administrative head and the regular pharmacist. The portal's architecture supports the creation of easily retrievable longitudinal databases of transactional records at the HCFs.

The e-Health platform has been fully implemented in all visited facilities in the Thiruvananthapuram district, while its rollout remains partial in other districts. As mentioned earlier, the modules of the e-Health platform are interconnected to replicate clinical workflows in hospitals. Regarding SCM, the platform's consultation module, accessed by physicians, generates electronic health records, including *e-prescriptions*. Pharmacists can access and print these e-prescriptions through the *pharmacy module*. The platform also records medicine availability and prescription fulfillment statuses. Unlike DDMS, the e-Health platform cannot retrieve longitudinal data but can generate daily reports at the end



DDMS

of OPD hours.

e-Health

HCFs use DDMS to monitor the movement of medicines and injections from the main storeroom to sub-stores and wards, while the e-Health platform tracks the consumption of units at the sub-stores and wards. Currently, there is no operational linkage between DDMS and the Pharmacy module of e-Health, as the latter is still being implemented. Once the e-Health platform is universally rolled out, interoperability between these systems will be crucial to streamline reporting, track unit movements effectively, and reduce the workload on healthcare personnel tasked with data entry across both platforms.

Field Observations

HCFs extensively utilized DDMS for the SCM of medicines and supplies. *Internet connectivity across the facilities was satisfactory, regardless of terrain*. Users universally reported *improved workflows with the introduction of DDMS*, highlighting enhancements in reporting, tracking, and processing medicine requests. The platform also reportedly minimized the scope for entry errors. *The portal's user-friendly interface was noted as a key strength*. In fact, some former private-sector employees now working in the public health system mentioned their ability to seamlessly engage with the portal for routine workflows even before receiving formal orientation.

Occasional server hang-ups and network latency have affected the timeliness of reporting. Feedback on the DDMS interface largely centered on its lack of user-friendliness for *managing non-medicine items*, an area that may require attention given its role in the SCM of all supplies needed by HCFs. Despite these concerns, the State has effectively streamlined DDMS implementation for SCM.

The e-Health platform is progressively emerging as a key tool for hospital operations management across the State, including the SCM of medicines. Valuable insights on the enablers and barriers to effective utilization could be picked up from HCFs with relatively advanced adoption of the e-Health platform, such as those in Thiruvananthapuram.

- Unlike DDMS, login credentials for the pharmacy module have been provided to both regular and contractual pharmacists. Contractual pharmacists retained at HCFs efficiently utilized the platform, *highlighting the importance of HR retention in enhancing both managerial and technical capacity for technological adoption*.
- The interconnected clinical flow and information-sharing features of the platform show significant potential in aligning clinical and prescription practices with the medicines and supplies available at HCFs.

- Pharmacists are required to input updated and accurate baseline data of sub-stock units into the pharmacy module for real-time tracking. However, this task was reportedly time-consuming and infrequently performed in facilities with high case-loads, frequent power outages, or network/server latency.
- Regular cadre MOs can view data on medicines available at the pharmacy through their login credentials, enabling them to enter information and generate e-prescriptions. Contractual MOs, lacking e-Health access, can only provide handwritten consultation and prescription slips. In the pharmacy module, the auto-deduction feature updates baseline data for medicines issued via e-prescriptions, while deductions for handwritten prescriptions have to be done manually.
- There is no mandate for generating only e-prescriptions in facilities equipped with the e-Health platform. Consequently, under certain circumstances, even some regular cadre MOs issued handwritten prescriptions.
- Entering baseline data into the pharmacy module was reported to be time-consuming, and manual deductions for handwritten prescriptions could not be performed in real time during high case-loads.
- These factors collectively made it challenging to maintain, calibrate, and utilize baseline data for prescriptions and tracking. To address these issues, pharmacists at most HCFs proactively updated prescribing physicians about stock availability via WhatsApp to support prescription decisions.
- From a supervisory perspective, senior State officials recognized HR shortages in the e-Health Program Management Unit as a key barrier to streamlining the monitoring of medicine movement across HCFs.

Some pharmacists voiced concerns about updating sub-stock units in the pharmacy module of e-Health. Their apprehension primarily stemmed from the unpredictable changes in medicine movement patterns caused by doctors' turnover and the resulting shifts in prescription preferences. Pharmacists feared they might be held accountable if slow-moving medicines expired due to these abrupt changes. This highlights gaps in the orientation provided regarding the portal's features and flexibility.

HUMAN RESOURCES FOR SUPPLY CHAIN MANAGEMENT

The universal adoption of an IT-enabled SCM system in the State is fundamentally dependent on the availability of skilled personnel across the supply chain. This study sought to examine the HRH structure for SCM in the State, assess capacity-building initiatives, and evaluate the overall availability and adequacy of human resources for effective SCM.

HRH Structure

KMSCL and DDWs

All HR at KMSCL were either contractually appointed, placed on a working arrangement, or deputed from relevant departments. At the time of the assessment, the State's MD NHM also held the position of Managing Director of KMSCL. The General Manager at KMSCL and the Warehouse Managers at DDWs were regular cadre staff from the Health Department on deputation. The Senior Superintendent and Administrative Officer were deputed from the Secretariat Department, while the Finance Director was deputed from the Finance Department.

At the DDWs, Assistant Warehouse Managers, Pharmacists, and Data Entry Operators were contractually hired by DHFW. Loading staff, packers, and security guards were either outsourced from agencies such as the Kerala State Ex-Servicemen Development and Rehabilitation Corporation (KEXCON), Kudumbashree, Kerala Headload Workers Welfare Board (KHWWB), and Kerala Security Service (KSS), or deputed from the Karunya Medicine Depot.

State and District Nodal Officers under DHS

Under the DHS, the following team of officers oversees the SCM of medicines at the State level:

Additional Director of Health Services for Medical and Hospital Administration (*ADHS - Medical*): Supported by a team comprising the Assistant Director (Pharmacy Services), the State Store Verification Officer (*SSVO*), and the Stores Officer (General Medical Stores) (*SoGM*).

Additional Director of Health Services (Family Welfare) (*ADHS - FW*): Assisted by the Stores Officer (Family Welfare) (*SoFW*).

The roles of State officials are supported by the District Medical Officer (*DMO*) and the Store Verification Officer (*SVO*). Additionally, State Program Officers actively contribute to the SCM of program-specific medicines and vaccines. Detailed responsibilities of these roles are outlined in the subsequent sections.

Healthcare Facilities

Supply chain management at HCFs was carried out by both regular and contractually hired pharmacists. Regular pharmacists were recruited through the Public Service Commission, while contractual pharmacists were appointed by the NHM, HMC, and LSGD. All regular pharmacists, including pharmacy storekeepers/superintendents, were designated as store custodians. Contractual pharmacists played a supportive role in operationalizing pharmacies and maintaining records. *All pharmacists in the States were assigned clearly defined administrative, clinical, legal, and public health responsibilities*.[35] The State's staffing norms for the pharmacists is shown below *(Table 23)*.

The regular pharmacists are members of various committees, including those for indent,

local purchase, condemnation, auction, hospital management, infection control, and quality assurance. They support MOs in the preparation and implementation of LSGD projects related to the procurement, storage, and distribution of medicines. *Regular pharmacists have exclusive access to update the DDMS portal and input information into the e-Health platform*. Contractual pharmacists, on the other hand, use the regular pharmacist's login credentials to access the DDMS portal and utilize the e-Health platform for dispensing medicines.

Table 23: Kerala's staffing regular pharmacists staffing norms

HCFs	Pharmacy Store Superintendent	Pharmacy Store Keeper	Pharmacists
DH/GH	1	1	4-5
TH/THQH	0	1	2-3
CHC/Block FHC	0	0	1-2
AAM-PHCs/ UPHCs	0	0	1

Training

The KMSCL head office conducts training sessions for Warehouse Managers to enhance their proficiency in warehousing activities. In accordance with directives issued by DHFW, [32] pharmacists who were in service during the rollout of DDMS reported receiving orientation and training from KMSCL officials. This training is now being extended to newly recruited staff as part of their onboarding process.

Kerala's SIHFW and SHSRC reportedly assist district functionaries (DMOs) in enhancing the store-management skills of pharmacists. Additionally, pharmacists benefit from extensive peer support in navigating the portal. Online learning modules for pharmacists are also accessible through the State's Learning Management System (*LMS*).

Overall, the adequacy of training was deemed satisfactory. The State's directives for transitioning to DDMS played a pivotal role in achieving its universal adoption by all store custodians, who demonstrated remarkable proficiency in utilizing DDMS for SCM activities. A notable best practice was the placement of intern doctors and pharmacists at DDWs for training in inventory management.

However, some pharmacists experienced delays in receiving adequate orientation or handover upon joining. This concern was more prominent in HCFs where pharmacists lacked prior experience or where HRH placements followed prolonged vacancies. Similarly, capacity-building and orientation of pharmacists during transfer postings to higher-level institutions require greater focus. The frequency of training sessions was reportedly inconsistent, as most updates were covered during review meetings, reducing the need for repeat training sessions.

Dedicated personnel have been appointed at the district level to provide training, handholding, and troubleshooting support for the e-Health platform. Training uptake

for the e-Health platform varied due to its phased implementation across districts.

Most pharmacists engaged during the study were found to be highly motivated, skilled, and enterprising. Those transitioning from the private sector were particularly enthusiastic about introducing knowledge and best practices into public hospitals. Suggestions to further improve services include establishing mechanisms to strengthen patient counseling, drug administration support, and drug information services.

Availability and Adequacy

KMSCL and DDWs

It was widely observed that KMSCL and DDW personnel demonstrated *high levels of competence, attributed to their prolonged engagement with the organization*. The retention of contractual staff for extended periods was identified as a key factor contributing to organizational efficiency and performance. However, *there is an urgent need to address HRH gaps, given the increasing operational demands at the head office and warehouses*.

At the KMSCL head office, only one dedicated staff member was assigned for IT support of the DDMS portal. Considering the number of entities linked to DDMS, this HR allocation appears to be insufficient. Similarly, DDWs faced shortages in HRH availability. Pharmacist vacancies were managed either by existing staff assuming additional responsibilities or by deploying pharmacists from KCPs on working arrangements to streamline workflows.

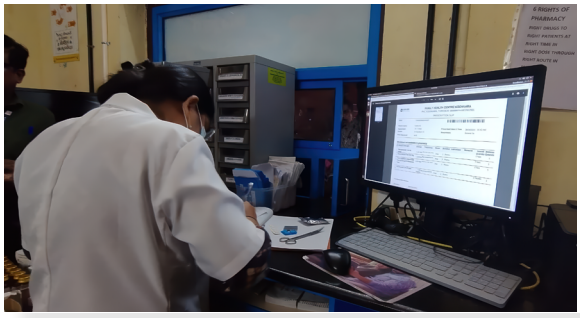
In most of the visited districts, the responsibilities of Warehouse Managers (WHMs) were either handled by a senior assistant warehouse manager or by a WHM deputed from another district. Discussions with these personnel revealed that HR shortages led to increased workloads, delays in the verification process during receipts and issues, and delays in dispatching medicines to HCFs.

District Officials

The study team interacted with the Store Verification Officers (SVOs) and SVOs in charge (SVO I/C) from two districts. One officer highlighted a concern about the frequency of audits, noting that certain HCFs had not been audited for over a decade. Manpower shortages and the demands of their primary roles were cited as the key reasons for this lapse.

Healthcare Facilities

Tables 24 and 25 present metrics of HRH for SCM of medicines in the State. Although there was a shortfall in the availability of regular cadre staff compared to State norms, overall availability was not a concern due to the co-positioning of contractual personnel.



e-Health

In fact, the gross staff availability exceeded the requirements outlined by the Indian Public Health Standards (IPHS).

Table 24: HRH Status – Kerala

HRH Status	Availability ratio (N=50)		Turnover rate (N=50)	Vacancy rate (N=50)	Recruitment for vacancies (N=50)	Deputation /Task-shifting/ Task-Sharing (N=50)	
	Regular cadre	Total (R+C)				% Positions against sanctioned	% Facilities observed doing this
Districts							
Idukki	0.75	1.00	0	0	48.67	6.35	10.00
Kozhikode	0.85	1.72	0	6.19	23.3	9.09	10.00
Palakkad	0.75	1.22	1.07	0.98	9.31	5.88	10.00
Thrissur	0.75	1.29	0.3	0	25.15	2.68	10.00
Thiruvanan-thapuram	0.54	1.00	10.2	13.27	25.51	0.00	0.00
HCFs							
DH/GH	0.51	1.00	2.56	1.54	69.23	53.85	40.00
TH/THQH	0.55	1.21	3.9	3.57	32.14	21.43	20.00
CHC/ BPHC	0.45	1.35	11.49	5.75	48.47	9.19	9.09
AAM	0.82	1.24	0	3.95	16.02	0.00	0.00
Pooled	**0.72**	**1.25**	**2.47**	**4.2**	**24.58**	**4.54**	**8.00**

Table 25: HRH Deficit (%) Against Requirements

HRH Deficit Against Requirements	IPHS Mean (95%CI)	State Norms Mean (95%CI)
Districts		
Kozhikode	-40.75 (-60.37, -21.12)	1.01 (-18.51, 15.26)
Palakkad	-40.63 (-60.93, -20.32)	15.26 (-64.62, -24.66)
Thrissur	-28.87 (-36.13, -21.61)	18.16 (-48.74, -2.60)
Thiruvananthapuram	-89.54 (-107.33, -71.75)	-18.37 (-80.27, -41.42)
Idukki	-65.87 (-91.08, -40.65)	-5.03 (-66.72, -36.46)

HRH Deficit Against Requirements	IPHS Mean (95%CI)	State Norms Mean (95%CI)
HCFs		
DH/GH	-1.63 (-12.19, 14.22)	-7.39 (-21.33, 6.54)
TH/THQH	-44.64 (-1.89, 32.40)	-62.50 (-98.38, -26.62)
CHC/ BPHC	-25.67 (-9.78, 46.09)	-24.14 (-47.59, -0.68)
AAM	-60.84 (-53.71, 16.98)	16.44 (6.33, 26.56)
Pooled	**-51.59 (-37.11, 27.06)**	**3.38 (-10.23, 16.98)**

The turnover and vacancy rates were highest among CHCs and Block FHCs. It is important to note that the *vacancy rate* indicator only reflects positions that remained unfilled throughout FY 2022–23. Interactions with providers revealed that some HCFs operated without regular cadre staff for brief periods due to delays in postings.

Despite these challenges, the facility-wise and pooled recruitment data against vacancies highlight responsive efforts to address gaps and reduce HRH disparities across facility types. These efforts were partly driven by HMCs and LSGDs, which played a key role in recruiting locally available skilled personnel as per requirements. As a result, uninterrupted service delivery at HCFs was maintained, even in the absence of regular pharmacists. The specific responsibilities of regular cadre pharmacists were managed at AAM-PHCs by deputed staff, while at secondary-level HCFs, these responsibilities were addressed through task-sharing.[36]

Although gross staffing availability might appear sufficient for day-to-day operations, feedback from pharmacists revealed a different perspective. The staffing norms in some upgraded facilities had not yet been revised from pre-existing standards. Furthermore, a few facilities reported that certain contractual positions under NHM were surrendered despite ongoing operational requirements.

Pharmacists highlighted that executing a wide range of responsibilities had become increasingly challenging due to the exponential growth in operational demands. *They emphasized the need to expand the workforce in line with evolving operational requirements to ensure equitable distribution of responsibilities*. This concern was particularly prominent among pharmacists working in round-the-clock facilities and secondary-level HCFs, who were also tasked with administrative duties related to block-level and LSGD health projects in addition to their routine responsibilities. The concerns need diligent attention as observations revealed that despite infrastructural gaps, adequate and skilled HRH could still achieve operational efficiency, resource optimization, and effective stock management, even in high-case load facilities.

AAM-PHCs (i.e., FHCs) are required to provide OPD services in two shifts, except on Sundays, necessitating the availability of contractual staff. *However, accessibility constraints were noted as a significant barrier to the participation and retention of contractual personnel*.

HCFs in Thiruvananthapuram reported that LSGDs were recently mandated to recruit

only one doctor and a maximum of one paramedical staff member (nurse, pharmacist, or lab technician) for their AAM-PHCs. In consultation with the institutional head, LSGDs strategically hired staff either to ensure the operational continuity of the facilities or to focus on revenue-generating services. The former approach was more prevalent in remote localities, while the latter aimed to strengthen the fiscal capacity of HMCs, enabling them to generate sufficient revenue to hire additional personnel. Under the new mandate, recruitment of additional pharmacists through LSGD funds for AAM-PHCs was notably lower in Thiruvananthapuram compared to other districts.

GOVERNANCE

The governance mechanisms for SCM of medicines within KMSCL functionaries closely resemble those of TNMSC. The mechanisms overseen by the DHS are tailored to the State's specific context. The activities of KMSCL and its subsidiaries are guided by protocols that have been largely standardized through practice. *However, KMSCL has yet to develop a consolidated operations-manual or document to formalize its procedures*.

Meanwhile, HCF operations are overseen by State and District functionaries under DHS and LSGDs. Data from the DDMS platform is extensively utilized by the State's internal supply chain stakeholders to support a wide range of governance-related activities.

State level

The KMSCL head office conducts weekly virtual monitoring meetings and quarterly in-person meetings with Warehouse and Karunya Depot managers to review operations. The Supply Chain Management (SCM) Division of KMSCL oversees DDW operations, the Quality Control (QC) Division manages quality assurance mechanisms, the IT Division handles DDMS portal-related activities, and the HR Division is responsible for human resource management.

Simultaneously, State officials under DHS oversee the supply chain of medicines. ADHS (Medical) and team monitor the supply chain of general medicines, while the ADHS (Family Welfare) and team manage the supply chain of Family Welfare Products. These teams work in coordination with KMSCL to monitor medicine utilization patterns and balance inventory availability across institutions, facilitating inter-institutional and inter-district medicine transfers.

The Assistant Director (Pharmacy Services) serves as an advisor to the ADHS (Medical) on human resource management within the Pharmacy and Medical Supplies Wing. The State Store Verification Officer (SSVO) acts as the technical assistant to the AD (Pharmacy Services). Both the AD (Pharmacy Services) and SSVO are authorized to conduct surprise inspections of hospital stores and sub-stores and are responsible for supervising and verifying medicine distribution across the State.

The Stores Officer (Government Medical Store) serves as the technical assistant to the ADHS (Medical) and handles matters related to the procurement of supplies

for various health service programs. This officer is also responsible for drafting procurement proposals within the program's budgetary limits, scrutinizing proposals from subordinate institutions for administrative and purchase approvals, and acting as the disbursing officer for government medical stores

The Stores Officer (Family Welfare) serves as the technical assistant to the ADHS (FW) and is responsible for managing the purchase, storage, and distribution of medicines from the State Family Welfare Store. This cadre is a member of various committees related to Family Welfare programs, condemnation, and auctions. The SoFW is mandated to collaborate with the ADHS (FW) in proposing infrastructure improvements for the stores, including fire-safety enhancements. Additionally, they are tasked with forwarding complaints regarding drug quality to the ADHS (FW), who in turn escalates these concerns to the Drugs Control Department and the procurement authority of the Ministry of Health and Family Welfare (MoHFW) to share information about sub-standard or banned drugs.

Most State officials are also accountable for managing the absence of store staff under their supervision.

District level

The Assistant Director (Pharmacy Services) convenes periodic conferences with the District Store Verification team to assess their performance. Similarly, the Stores Officer (Family Welfare) holds regular meetings with the officers in charge of District Family Welfare Stores to address any issues related to the supply of Family Welfare Products provided by the Government of India.

The District Store Verification Officer (SVO) serves as the technical assistant to the District Medical Officer (DMO) and oversees matters related to the purchase, storage, and distribution of medicines. The District SVO is also a member of program implementation committees at the district level.

The District SVO convenes monthly District Conferences of pharmacists, organized at the District Medical Office (Health), which are attended by the Warehouse Manager or manager in charge. Since COVID-19, these meetings have been conducted virtually. While the virtual arrangement is cost-efficient, many pharmacists interviewed for the study expressed their preference for resuming physical meetings, viewing them as vital platforms for knowledge sharing and professional networking. These conferences also provide institutional pharmacists with opportunities to voice concerns related to supplies and human resources, enabling supervisory officials to address these issues.

The District SVO is responsible for organizing periodic continuing education programs and in-service training for officials. Additionally, they conduct quarterly inspections of stores, with particular attention to high-value medicines. Other responsibilities of the District SVO closely align with those of the State SVO

Each district has a 'Condemnation Committee' that includes the DMO, representatives from the Pollution Control Board, the Drug Inspector, the SVO, and the DDW Manager. This committee is responsible for providing administrative oversight and approval for the condemnation process of both biomedical and bio-toxic wastes.

Healthcare Facility Level

At HCFs, the pharmacist with the senior-most rank oversees supervisory roles and administrative tasks related to the main store and sub-stores. In secondary-level HCFs with more than one regular pharmacist, these responsibilities may be delegated to a senior pharmacist, Pharmacy Store Keeper, or Pharmacy Store Superintendent, depending on institutional HR norms and staff availability. At primary-level HCFs, these roles are carried out by the regular pharmacist alongside their clinical duties.

Pharmacists with supervisory roles serve as the technical assistants to the institutional head and are members of various committees, including those for local purchase, program implementation, condemnation, auction, and hospital management. They assist institutional heads in preparing and submitting proposals for medicine SCM under LSGD and State health projects, as well as infrastructure upgrades for storage spaces in coordination with district officials.

The pharmacist in charge also acts as the *Institutional Store Verification Officer*, overseeing the verification and inspection of supplies to the main store and monitoring storage practices. They report stock surpluses or deficits and any quality concerns to the institutional head for necessary action and escalation. Their supervisory role also empowers them to build capacity within the in-house team. Additionally, as members of the Institutional Condemnation Committee, they coordinate with district counterparts to report dead-stock inventory and facilitate reverse logistics.

Prescription audits (*PA*) are conducted in most facilities by a committee comprising the institutional head, nursing officer, pharmacist, an additional physician, and, where available, a lady health inspector. However, *the rigor, frequency, and awareness of audit formats varied across facilities*. Currently, facilities are expected to audit handwritten prescriptions only, as audits of e-prescriptions are reportedly managed at the State PMU (*e-Health*). Notably, an FHC and a GH in Thiruvananthapuram were found to be conducting monthly audits of both handwritten and e-prescriptions. The audit checklists developed by these PA teams identified areas for improving e-prescription practices.

LSGD and Institutional Mechanisms

LSGD's Health Standing Committee, Ward Health Sanitation and Nutrition Committee (WHSNC), and Area/Community Development Society (ADS/CDS) work collaboratively to ensure access to quality and affordable healthcare services, including medicines, for the empaneled poor and vulnerable population sub-groups within their catchment areas. They have implemented a system to map population sub-groups to appropriate functionaries, facilitating a seamless treatment-seeking experience across the care continuum. *Community Health Workers, volunteer groups, and SC/ST Promoters from the Tribal Department actively collaborate with hospital-based functionaries to ensure that beneficiaries of various schemes receive their entitled services, including medicines, without any barriers*.

Liabilities

In the context of clearly defined roles and responsibilities for all cadres involved in the medicine supply chain, the State has established guidelines to address supervisory lapses and store discrepancies, such as stock surpluses or deficits, that could lead to financial liabilities for the responsible cadres. Any wastage lacking reasonable justification must be financially compensated by the staff deemed accountable. This disciplinary action applies to all medicine items received on request. However, units wasted from unsolicited supplies are not subject to rigorous scrutiny.

Quality Control

Quality management forms an essential component of KMSCL's governance framework, adopting processes similar to those of TNMSC. Quality assurance measures are implemented from the stage of vendor empanelment, ensuring companies with inadequate production capacities—unable to fulfill timely and complete requirements—are filtered out.

During the dispatch of supplies to the DDWs, manufacturers are required to submit both in-house test reports and NABL-certified reports to the Quality Control (QC) Division of KMSCL for scrutiny. The QC Division evaluates these reports and updates its decisions—categorized as Approved, Rejected, or Clarification Sought—on the DDMS platform, accessible to both manufacturers and DDWs. Only batches approved by the QC Division are accepted, stocked, and distributed by the DDWs.

KMSCL has empaneled analytical testing laboratories through a transparent process conducted under expert supervision. In addition to the QC report from an NABL-certified lab submitted by the supplier, the QC Division also receives batch samples from DDWs or HCFs for quality assessment. The samples are masked and anonymized using DDMS-generated codes before being transported to the empaneled laboratories for testing.

If a laboratory determines that a batch sample is 'Not of Standard Quality' (NSQ), KMSCL issues a 'Freeze' memo to the relevant DDWs and HCFs, instructing them to suspend the distribution of medicines from that batch. Simultaneously, the Drugs Controller is notified for statutory sampling. If the batch is again reported as NSQ following subsequent testing, KMSCL issues a 'Stop' memo directing all DDWs and HCFs holding the respective batch to cease its distribution, recall the medicines from sub-stores or HCF stores, and quarantine the batch in accordance with established protocols. Conversely, if the batch passes the quality test, instructions are issued to resume the distribution of the approved batch.

The same procedure is followed whenever an HCF raises a complaint about a specific batch of medicines. All HCFs have been provided with a complaint register and a toll-free number to report issues, including Adverse Drug Reactions. This toll-free number was prominently displayed in front of the pharmacies at most government hospitals visited during the assessment. For redressal, KMSCL coordinates with the DDWs to determine whether complaints about the same batch of medicines have been raised by other institutions and may recommend site inspections of the concerned

HCFs to assess storage conditions. Additionally, the Drug Inspector under the Drugs Controller is tasked with initiating statutory analysis of samples from the batches supplied through KMSCL.

Tollfree number

The quality of medicines is a critical requirement for empaneled manufacturers to maintain their business with KMSCL. If multiple batches of the same medicine, or different items produced by the same manufacturer, fail quality standards within a defined timeframe, this can result in partial or complete blacklisting of the vendor.

Performance standards are detailed in the Memorandum of Agreement (MoA), including specific requirements for labeling, boxing, and packaging. These standards aim to promote transparency, minimize supplier bias, and improve clarity in segregation and distribution. Payments to suppliers meeting the MoA requirements are initiated once the DDWs update the receipt of supplies in the DDMS, typically within 45 days. However, feedback revealed instances of delayed payments due to fiscal constraints, causing subsequent delays in supply deliveries.

KMSCL plays a pivotal role in facilitating the condemnation process for dead stock resulting from quality failures. The responsibility for condemning dead stock due to product expiration lies with the HCFs. Under the directions of the Condemnation Committee, the DDWs manage the reverse logistics of NSQ medicines quarantined at HCFs, ensuring their disposal through an empaneled agency specializing in bio-toxic waste. Recovering costs for condemned stock from suppliers of failed batches is reportedly a lengthy and complex process, often involving legal challenges.

Field Observations

DDMS serves as the communication channel for disseminating QC results to stakeholders, facilitating necessary actions. Some pharmacists emphasized the need to enhance alert mechanisms for quarantined batches approved for re-distribution, as failure to notice their release could risk wastage. This issue was also cited by a DDW Manager as a contributing factor to expiries at HCFs.

The State has implemented comprehensive measures, including infrastructure development, HR training, governance mechanisms, and optimized business operations, to uphold performance and quality standards. Despite these efforts, issues such as *tablet fragmentation or dissolution were reported and observed in HCFs*. These challenges were speculated to stem from spatial constraints in temperature-controlled rooms and the tropical monsoon climate of the State, although the exact causes remain uncertain. Pharmacies occasionally noted packaging problems, including tampered boxes, empty strips, and labeling errors involving look-alike medicines.

The condemnation process has experienced substantial delays, spanning approximately five years, leading to significant accumulation of dead stock at DDWs and HCFs. This has exacerbated existing spatial constraints.

Fragmented tablets

From a health systems perspective, *experienced pharmacists acknowledged significant improvements in the performance and quality of medicines following the establishment of KMSCL and DDMS for SCM*. They highlighted that the government now provides over Rs. 1,000 crores worth of medicines, which undergo four rounds of quality testing, free of cost to the public. However, when comparing public and private sector approaches, the latter exhibited less emphasis on quality assurance. Despite these advances, the public sector still faces disproportionate media and public criticism for medicine shortages and confronts mistrust regarding the quality of generic medicines.

Dead stock

FORECAST

KMSCL initiates the forecasting and indenting exercise during the second or third quarter of the ongoing financial year (FY) to plan for the upcoming year. As part of the routine forecast, the agency gathers details of items to be procured under NHM projects and prepares a tentative medicine list that is scrutinized against pharmacopeia standards. To support this process, *KMSCL conducts regional workshops to discuss procurement procedures and indenting guidelines for the next FY*. HCFs are then invited to suggest revisions to the medicine list.

Following this collaborative exercise, KMSCL convenes a sub-committee meeting to finalize the medicine list, define financial caps, allocate medicines under different heads (e.g., NHM, DHS, DME, Kerala Social Security Mission, Kerala AIDS Control Society, Prisons), and determine the timeline for each process. The finalized list and associated decisions are communicated to the State government, KMSCL's IT Division, and HCFs.

The indenting process begins with the issuance of a guidance letter to HCFs, providing direction for the indenting exercise. Subsequently, the IT Division enables the Online Indenting feature within the DDMS platform. Each facility receives a preliminary indenting format aligned with their allocated financial ceiling, which can be customized based on the facility's forecasted needs. Facilities are required to complete the indenting exercise within the assigned timeline.

Once submitted, the indents are reviewed by the district-level committee before being forwarded to State-level officials for verification, consolidation, and approval. Upon approval, the finalized State list is sent to KMSCL, and the IT wing locks the indenting option on the DDMS platform.

Since the process is done through the DDMS across the stakeholders, it was possible to objectively verify the rigor of the exercise done by each facility for FY 22-23 with respect to the actual consumption *(Table 26)*, previous year's consumption *(Table 27)*, and changes to the HCFs' financial allocation *(Table 27)*. *It is important to note that actual data on forecasted quantities was not maintained in the State's database*. Instead, facilities directly raised online indents based on their forecasted requirements. As a result, the available indent data was retrieved and utilized as a *proxy measure for assessing forecast accuracy*.

Table 26: Forecast accuracy of tracer medicines procured for FY 22-23

Districts	n	Mean (%)	L.SE	95% CI	
Idukki	10	87.45	2.53	82.05	92.84
Kozhikode	10	113.39	3.90	105.07	121.71
Palakkad	10	99.90	2.19	95.23	104.58
Thiruvananthapuram	10	122.48	3.25	115.56	129.41
Thrissur	10	92.57	6.04	79.70	105.45
HCFs					
DH/GH	5	119.66	5.84	107.22	132.10
TH/THQH	5	130.81	5.25	119.62	142.01
CHC/ BPHC	11	107.48	7.11	92.32	122.65
AAM-PHC	29	100.27	4.83	89.98	110.56
Pooled	**50**	**104.12**	**3.70**	**96.23**	**112.01**

Source: Sampled HCFs

Table 27: Change in consumption between FY 21-22 and FY 22-23

Districts	n	Mean (%)	L.SE	95% CI	
Idukki	10	3.98	3.79	-4.27	12.24
Kozhikode	10	22.33	11.17	-2.02	46.67
Palakkad	0	Data not retrieved			
Thiruvananthapuram	10	25.97	1.69	22.28	29.66
Thrissur	10	35.53	3.30	28.34	42.71
HCFs					
DH/GH	4	41.02	9.87	19.51	62.53
TH/THQH	4	42.59	25.56	-13.09	98.28
CHC/ BPHC	9	27.53	5.00	16.62	38.43
AAM-PHC	23	21.26	5.35	9.61	32.92
Pooled	**40**	**24.46**	**4.49**	**14.68**	**34.24**

Source: Sampled HCFs

Table 28: Change in Financial Allocation between FY 21-22 and FY 22-23

Districts	n	Mean (%)	L.SE	95% CI	
Idukki	10	29.14	2.27	24.21	34.08
Kozhikode	10	39.70	1.38	36.70	42.71
Palakkad	0	Data not retrieved			
Thiruvananthapuram	10	34.58	1.75	30.77	38.39
Thrissur	10	18.97	2.19	14.21	23.73
HCFs					
DH/GH	4	36.80	4.69	26.58	47.02
TH/THQH	4	38.26	4.09	29.35	47.18
CHC/ BPHC	8	28.98	6.45	14.94	43.03
AAM-PHC	24	28.83	3.04	22.21	35.45
Pooled	**40**	**29.79**	**2.07**	**25.28**	**34.31**

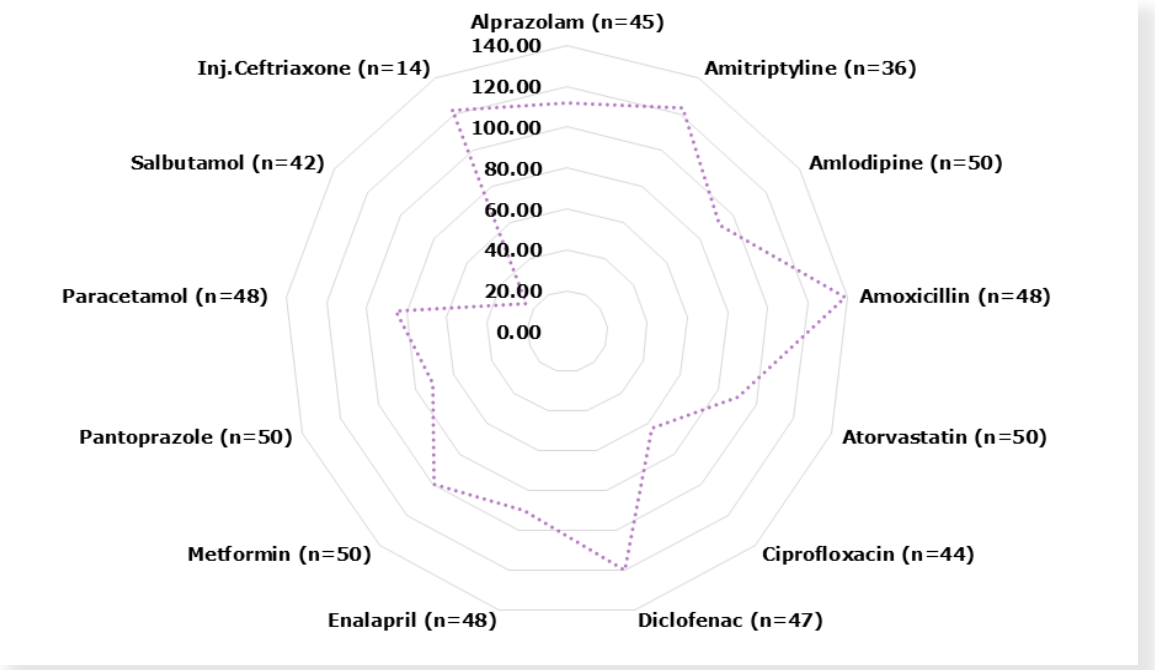
Source: Sampled HCFs

The aggregate forecast accuracy was deemed satisfactory in relation to the annual requirements. Notably, there has been an approximate 30% increase in financial allocation and a 25% rise in medicine consumption across two consecutive financial years.

Most HCF providers reported insufficiency in the financial ceiling allocated for indenting in accordance with actual demand. This concern was also echoed by DDW personnel, who noted that certain AAM-PHCs required more than twice their assigned financial allocation to meet their demand. Although there is a provision for raising additional indents toward the last quarter of the financial year, allowing up to 25% of the annual requirement, approval and receipt under this flexibility depend on multiple factors. Consequently, providers often rationalize their indent line items to stay within the financial ceiling. Fast-moving and high-volume, low-cost medicines were prioritized—and at times even over-indented—to address these constraints. These discrepancies are particularly evident when analyzing the forecast accuracies of individual tracer medicines *(Figure 16)*.

This situation is prevalent across the State, highlighting a supply-side *reliance on indent data rather than forecast data*. Forecasting refers to a prediction of future demands, excluding unforeseen events, while indenting reflects the actual quantities requested or ordered. These quantities are influenced by factors such as budgetary constraints, lead times, perceived risks of stockouts or overstocking, and human error in the ordering process. Indent estimates are inherently biased, making it challenging to directly infer or compare forecast accuracy over time or across different locations within the State. Furthermore, such estimates may obscure underlying issues in the forecasting process, potentially leading to poor inventory management outcomes, including stockouts or overstocking at HCFs.

Figure 16: Forecast accuracy of tracer medicines during FY 22-23 (%)



To further examine the limitations of the existing annual indent exercise, the complement of the consumption ratio was calculated. A positive value represents the proportion of units not consumed, while a negative value indicates the proportion of

consumption sourced from means other than direct receipt from KMSCL during FY 2022–23. *The findings across districts and HCFs revealed that approximately 22% of aggregate consumption was derived from alternative sources, such as previous inventory, local purchases, or inter-facility transfers*. In contrast, in Idukki, around 3% of aggregate units remained unconsumed during FY 2022–23.

Table 29: Consumption pattern with respect to actual supplies from KMSCL during FY 22-23 (%)

Districts	n	Mean (%)	L.SE	95% CI	
Idukki	10	2.79	1.98	-1.42	7.01
Kozhikode	10	-15.08	7.42	-30.88	0.73
Palakkad	10	-5.23	1.80	-9.07	-1.38
Thiruvananthapuram	10	-33.48	3.41	-40.74	-26.22
Thrissur	10	-44.87	5.79	-57.20	-32.53
HCFs					
DH/GH	5	-27.55	6.46	-41.31	-13.79
TH/THQH	5	-53.94	14.71	-85.31	-22.58
CHC/ BPHC	11	-23.96	6.45	-37.70	-10.22
AAM-PHC	29	-18.23	6.65	-32.41	-4.06
Pooled	**50**	**-21.91**	**4.64**	**-31.80**	**-12.03**

Source: Sampled HCFs

The State's model deserves recognition for its longitudinal database supporting the annual estimation exercise. However, there is a pressing need to develop forecast data alongside indent data to strengthen decision-making processes. Reflecting field realities, stakeholders have suggested consolidating supplies under the EDL and NHM projects into a single category. This approach aims to minimize overlaps in indents raised under various schemes and expand the overall availability of medicines to HCFs.

PROCUREMENT

The finalized list of medicines includes the Essential Drug List, Specialty Drug List, and Anti-Cancer Drugs. Once KMSCL receives the requirements for a financial year, an invitation for tender is published on the e-Tender portal. Selected technical bids are evaluated for price bidding within established timelines for each medicine category. The empaneled suppliers for each FY consist of L1 bidders and matching bidders. As per State policy, Kerala State Drugs and Pharmaceuticals Limited (KSDP) is perpetually empaneled with KMSCL for supplies.

Purchase orders (POs) for supplies are placed toward the end of the ongoing FY to ensure the commencement of medicine delivery within 60 days of order placement. Reportedly, KMSCL issues approximately four POs in a single FY. For medicines categorized as 'No Bidder Item' (NBI), KMSCL endeavors to procure supplies through the Karunya Sales Wing. However, procurement volume via this channel tends to be lower compared to the global tender process due to higher tender rates set by bidders empaneled with the Karunya Sales Wing.

Tables 30 and 31 illustrate the average unit cost incurred for issuing a bundle of tracer medicines for FY 22-23. The variation in bundled costs between the population level and the sample facilities can be attributed to the defined scope of the study under each directorate and the varying demand for each tracer medicine. These figures are merely indicative of the costs incurred by the government when undertaking volume-based purchasing.

Table 30: Bundled unit cost of issuing procured tracer medicines to facilities (INR) – Population data

Districts	INR
Idukki	1.9462
Kozhikode	1.9088
Palakkad	1.9454
Thiruvananthapuram	1.9405
Thrissur	1.9418
Pooled	**1.9252**

Source: KMSCL

Table 31: Bundled unit cost of issuing procured tracer medicines to HCFs (INR) – Sample Data

Districts	n	Mean	L.SE	95% CI	
Idukki	10	0.9270	0.2271	0.4429	1.4111
Kozhikode	10	0.8680	0.1184	0.6156	1.1204
Palakkad	10	0.7546	0.1127	0.5144	0.9949
Thiruvananthapuram	10	1.0029	0.1338	0.7177	1.2880
Thrissur	10	0.9087	0.2144	0.4516	1.3657

Districts	n	Mean	L.SE	95% CI	
HCFs					
DH/GH	5	2.0429	0.0322	1.9743	2.1115
TH/THQH	5	1.8424	0.2749	1.2564	2.4283
CHC/ BPHC	11	1.1152	0.1250	0.8487	1.3817
AAM-PHC	29	0.7060	0.0335	0.6346	0.7774
Pooled	**50**	**0.8903**	**0.0764**	**0.7274**	**1.0533**

Source: Sampled HCFs

Local Purchases

In addition to KMSCL, LSGDs provide support to HCFs under their jurisdiction by allocating project funds for the purchase of medicines and consumables beyond the indented requirements. *This supplementary funding has been instrumental in addressing operational demands that surpass the routine supplies received from KMSCL.* However, this support is contingent upon the availability of LSGD funds and the extent to which KMSCL meets the requirements. Furthermore, some HCFs reported discrepancies in fund allocation due to jurisdictional overlaps, resulting in either additional or insufficient funding from LSGDs.

Local purchase medicines

Although certain HCFs utilize HMC funds for local medicine purchases, providers expressed reluctance to divert this funding pool for medicine procurement. In cases where HMC funds were used, the expenditure was reportedly recovered from the LSGD funds earmarked for medicines.

In addition to these measures, certain high-case-load secondary HCFs have empaneled private pharmacies to provide free medicines to Below Poverty Line (BPL) patients and beneficiaries of government health schemes referred to them during periods of supply shortfalls at the HCFs. Payments to these pharmacies are processed through a centralized mechanism after the submission of purchase bills to the respective hospitals.

For any local purchase, institutional heads act as the designated purchasing authority, while the regular pharmacist facilitates the procurement process. HCFs may resort to local purchasing only when the required medicines cannot be supplied by KMSCL. Common scenarios that justify local purchasing include:

- Non-availability of EDL medicine(s) with KMSCL for any reason.
- Requirements outside the EDL scope for HCFs.

- Emergency demands arising from unforeseen circumstances.
- Complete exhaustion of annual indented quantities.
- Non-availability of required medicines from other DDWs or HCFs that could have been re-appropriated.

Under these circumstances, any HCF opting for local purchasing must first obtain a 'Non-Availability Certificate' from the respective DDW, while committing the fund source for the intended purchase. Upon approval from the SVO, the HCF may proceed with local purchases.

The State is required to make an upfront payment to KMSCL (SCM or Karunya Sales Wing) for medicine procurement, while transactions involving LSGD funds or State health insurance/schemes can be processed after submitting attested bills for local purchases via the State-run portal. These complementary mechanisms aim to alleviate the financial burden on users and enhance access to free medicines for public health system users.

However, some secondary HCFs have reported that payment backlogs in insurance-based reimbursements to empaneled private providers have discouraged their participation in subsequent empanelment rounds. This situation has adversely affected access to free medicines for beneficiaries during periods of supply shortfalls at the HCFs.

To ensure the optimal use of resources in medicine procurement, the State has issued directives mandating HCFs to prioritize specific not-for-profit entities (listed below) for local purchases. If these entities are unable to fulfill the required supply, hospitals may proceed to procure medicines from private suppliers through a transparent mechanism.

Entity	Ownership
Karunya Community Pharmacy	Kerala Medical Service Corporation Limited
Karunya Maveli Stores	Kerala State Civil Supplies Corporation
Jan Aushadhi Kendra	Central Government
Neethi Stores	Kerala State Co-operative Consumer's Federation
Kerala State Drugs and Pharmaceuticals Limited	Government of Kerala
In-House Drug Bank	Hospital Development Society of Shri Avittom Thirunal hospital, Thiruvananthapuram

As observed, most of the listed not-for-profit entities are *governmental enterprises*. The State has strategically utilized supply chain flexibility to achieve dual objectives—*enhancing supply chain resilience for HCFs and ensuring a guaranteed market*

for governmental enterprises. This strategic interdependence aligns governmental entities more closely with the State's public health goals and priorities compared to for-profit private entities. Additionally, working with a smaller, familiar pool of governmental entities simplifies the administrative process for HCFs, as opposed to navigating a broader network of private vendors.

However, this approach is not without its trade-offs. Mandating purchases from specific governmental entities may inhibit price competition, as these entities are not necessarily the most cost-effective options. Data on unit costs revealed that medicines procured from governmental entities were generally more expensive compared to those supplied by empaneled private entities. While this study did not delve into the factors driving these cost differences, it is worth noting that the average unit cost incurred by the State (through LSGD) or HCFs (through HMC) for local purchases was higher than the costs achieved by KMSCL through economies of scale *(See Figure 17)*. This discrepancy is partly due to KMSCL's focus on supplying generic molecules, whereas branded generics or branded medicines are often procured from entities empaneled for local purchases.

During provider interactions, several concerns were raised regarding repeated instances of long lead times, delays, and partial fulfillment of local purchase orders from a specific governmental entity, which also required upfront payments. These inefficiencies, detrimental to service continuity, have led to reluctance among providers to continue local purchases from the entity. However, during store inspections, they were penalized with negative scores for opting for subsequent local purchases from other viable suppliers instead of the mandated entity. This highlights that the *mandated approach can create a conflict of interest between supervisory officials and service providers*. Supervisory officials tend to prioritize where resources should be allocated, while providers focus on using the available resources to meet service delivery goals. This finding underscores the necessity of *establishing performance standards for the governmental entities identified for fulfilling local purchase requirements*. Clear benchmarks can help ensure accountability and reduce inefficiencies that compromise service delivery.

Tables 32, 33, and 34 show proportion of annual consumption catered by KMSCL through direct indents, transfers and schemes, and through Local Purchases. *Figure 18* represents the same for each tracer medicine.

Figure 17: Average unit cost (INR) of tracer medicines procured from KMSCL and purchased locally during FY 22-23

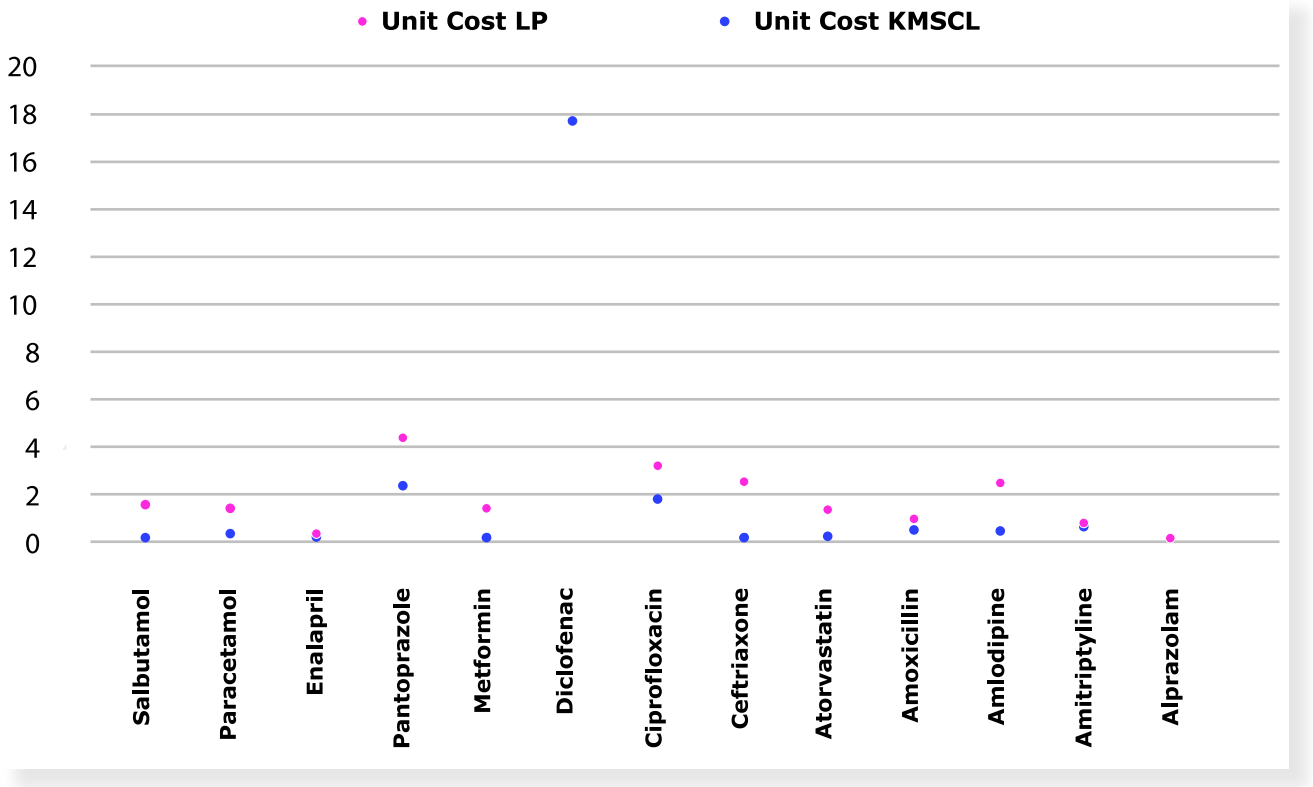


Table 32: Proportion of total consumption at HCFs catered through direct indents for FY 22-23

Districts	n	Mean	L.SE	95% CI	
Idukki	10	83.05	2.11	78.55	87.55
Kozhikode	10	80.71	0.48	79.69	81.74
Palakkad	10	91.93	1.01	89.77	94.09
Thiruvananthapuram	10	78.91	2.76	73.02	84.81
Thrissur	10	77.19	1.00	75.06	79.31
HCFs					
DH/GH	5	89.22	2.11	84.72	93.72
TH/THQH	5	81.75	3.77	73.71	89.79
CHC/ BPHC	11	85.44	2.71	79.67	91.22
AAM-PHC	29	81.20	2.21	76.50	85.91
Pooled	**50**	**82.23**	**1.59**	**78.84**	**85.61**

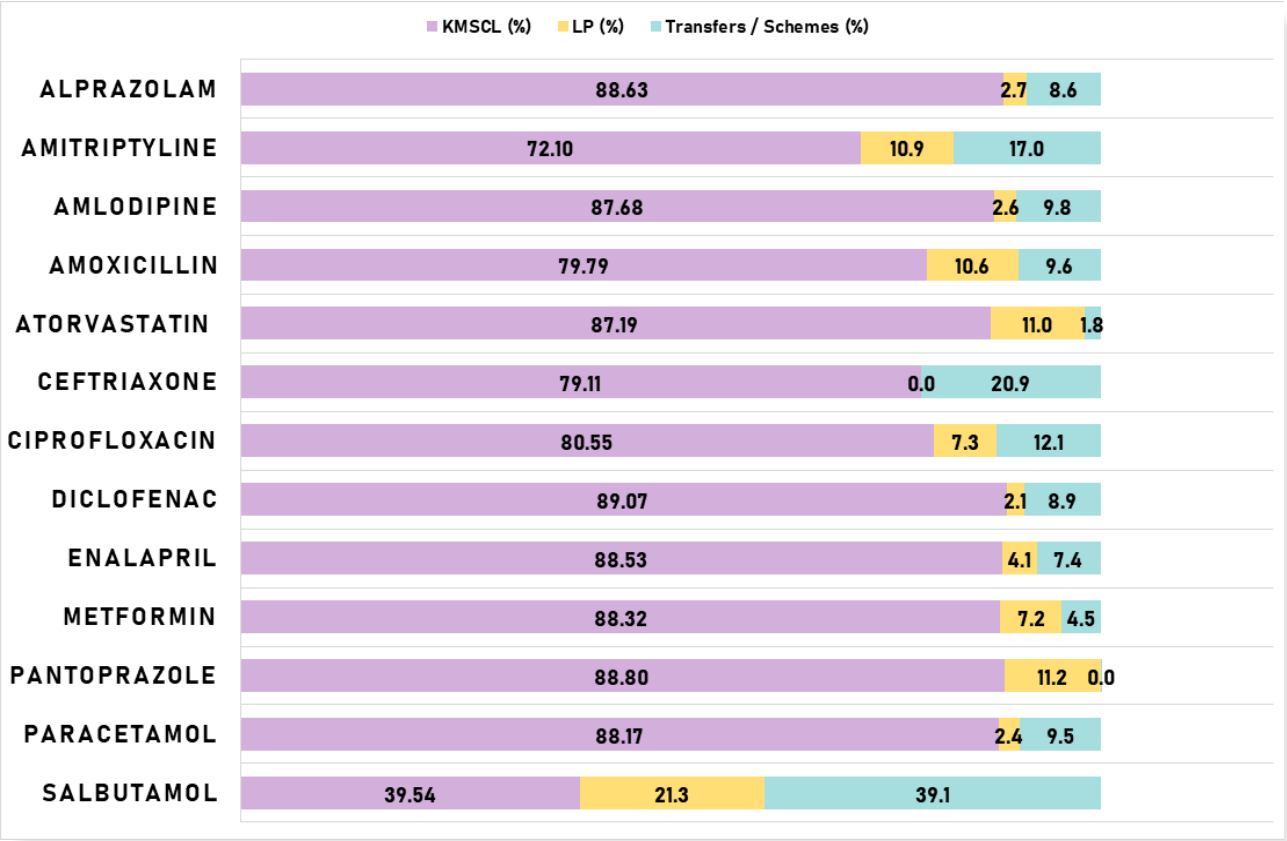
Table 33: Proportion of total consumption at HCFs catered through transfers/ schemes for FY 22-23

Districts	n	Mean	L.SE	95% CI	
Idukki	10	12.45	1.31	9.67	15.24
Kozhikode	10	13.49	1.14	11.06	15.93
Palakkad	10	4.16	0.74	2.59	5.73
Thiruvananthapuram	10	13.92	1.71	10.29	17.56
Thrissur	10	8.96	1.70	5.33	12.59
HCFs					
DH/GH	5	10.07	1.91	6.00	14.14
TH/THQH	5	12.34	3.51	4.85	19.82
CHC/ BPHC	11	6.16	1.63	2.69	9.63
AAM-PHC	29	11.21	1.73	7.53	14.89
Pooled	**50**	**10.31**	**1.33**	**7.47**	**13.15**

Table 34: Proportion of total consumption at HCFs catered through local purchases for FY 22-23

Districts	n	Mean	L.SE	95% CI	
Idukki	10	4.50	0.81	2.77	6.23
Kozhikode	10	5.80	0.79	4.10	7.49
Palakkad	10	3.91	0.50	2.83	4.99
Thiruvananthapuram	10	6.89	1.05	4.66	9.13
Thrissur	10	13.85	1.32	11.04	16.67
HCFs					
DH/GH	5	0.78	0.19	0.37	1.18
TH/THQH	5	5.91	0.90	4.00	7.82
CHC/ BPHC	11	8.40	2.90	2.21	14.59
AAM-PHC	29	7.50	1.27	4.80	10.21
Pooled	**50**	**7.41**	**0.92**	**5.44**	**9.38**

Figure 18: Proportion of annual consumption at HCFs catered by KMSCL, Local Purchases, and Transfers / Schemes during FY 22-23



Considering the combined supply of medicines through direct indents, transfers, and schemes, KMSCL meets approximately 93% of the annual requirements at HCFs. The remaining demand is primarily addressed by re-appropriating excess stock from other facilities, obtaining additional supplies through local purchases, and utilizing the balance stock from the previous financial year.Information regarding medicines classified as No Bidder Items (NBIs) is typically shared late in the procurement cycle, exposing a potential supply gap equivalent to the value of NBIs for that fiscal year. For instance, Salbutamol was identified as an NBI during FY 2022–23 *(Figure 18)*. Currently, no State policy exists to reimburse the value of NBIs or partially fulfilled supplies to HCFs for procuring alternative medicines.

DISTRIBUTION AND LOGISTICS MANAGEMENT

Essential Medicines ordered through KMSCL are supplied by the vendors to the DDWs. Although the State has 16 DDWs, 3 depots for the Karunya Community Pharmacies, 2 for LSGD projects and 1 in-house drug bank, the present study focused only on assessing the distribution and logistics management of essential medicines through the DDWs.

The DDWs serve as the point of receipt, inventory and logistics management of the supplies. They function as the collection hub of medicines from the empaneled

suppliers; other DDWs during inter-warehouse transfers (*IWTs*), and the dead-stock from HCFs for condemnation. The warehouses receive purchase order supplies and distribute the same on a quarterly basis, allowing hospitals to prioritize batch movements and reduce wastage using the 'First Expiry First Out' (*FEFO*) method. Additionally, the DDWs receive supplies procured under NHM and State-specific schemes for their distribution to the facilities. Through IWT, the SCM Division of KMSCL reallocates supplies from DDWs with surpluses to those facing deficits. This provision contains procurement cost and lead-time; balances inventory and reduces wastage. DDMS facilitates the process through real-time monitoring of all DDWs' inventories. Transportation of IWT units is done through empaneled logistics service providers. *During crises situations such as critical shortfall of life saving medicines/ vaccines or natural disasters, the States of Kerala and Tamil Nadu reach out to their respective medical service corporation to meet any emergency requirements*.

Tables 35 and 36 show the quantity and value of supplies received and issued by the DDWs during the assessment period (FY 22-23). *Table 37* shows the quantity of medicines received and issued by the DDWs as IWTs during FY 22-23.

District Drug Warehouses

Table 35: Supplies from KMSCL issued by DDWs against indent of tracer medicines during FY 22-23

KMSCL Supplies	Mean (%)	LSE	95% CI	
Total Units				
Idukki	90.99	6.31	78.56	103.42
Kozhikode	92.35	6.46	79.63	105.08
Palakkad	87.52	6.10	75.51	99.54
Thiruvananthapuram	95.82	5.38	85.22	106.42
Thrissur	93.96	5.76	82.61	105.31
State (All districts)	92.64	1.54	89.62	95.67
Value (INR)				
Idukki	95.63	6.71	82.43	108.84
Kozhikode	96.28	6.83	82.84	109.73
Palakkad	91.86	6.39	79.28	104.44
Thiruvananthapuram	100.05	5.85	88.54	111.56
Thrissur	98.50	6.23	86.24	110.76
State (All districts)	96.85	1.63	93.64	100.07

Data source: KMSCL

Table 36: Total Supplies received and issued by DDWs against indent of tracer medicines during FY 22-23

Total Supplies	Received by DDWs		Issued to HCFs	
	Quantity	Value (INR)	Quantity	Value (INR)
Districts	**Mean (%)**	**Mean (%)**	**Mean (%)**	**Mean (%)**
Idukki	101.60	107.28	95.35	100.63
Kozhikode	102.22	107.38	99.37	103.00
Palakkad	103.33	108.84	95.73	100.53
Thiruvananthapuram	101.27	108.62	98.14	103.25
Thrissur	104.50	106.36	97.08	102.03

Data source: DDWs

Table 37: Quantity of tracer medicines received and issued by DDWs as IWTs against total receipt and issue for the FY 22-23

Inter-warehouse transfers by DDWs	Received quantity	Issued quantity
	Mean (%)	Mean (%)
Kozhikode	0.41	0.15
Palakkad	0.33	0.00
Thrissur	0.43	0.01
Thiruvananthapuram	0.20	0.20
Idukki	0.21	0.38

Data source: DDWs

As it can be seen in *Tables 35 and 36*, the differences in the quantity issued by DDWs against indent in KMSCL's and DDWs' records are because KMSCL dataset highlights the supplies made by the vendors against annual indent, whereas DDW records also reflect the supplies received from NHM schemes and IWTs over and above receipt against indents.

The location of the DDW(s) within each district and the warehousing capacity are enablers of timely distribution of medicines. None of the HCFs reported inconvenience to access their DDW. Even in Idukki, a hilly district, the DDW was recently shifted to a location that facilitates equal access to high-range and low-range HCFs. In Thiruvananthapuram, a supplementary DDW was established to compensate for the capacity constraints of the main DDW.

Life-saving medicines such as Equine Rabies Immunoglobulin (ERIG) or anti-hemophilia factors are supplied on priority. Essential medicines are supplied to the HCFs based on a schedule developed by the DDWs functionaries. During interactions with the DDW personnel, it became evident that *experienced DDWs personnel had thorough demographic and spatial awareness, and demand fluctuations in the HCFs of their district*, which often went into planning their distribution schedule and route map to the HCFs. *Effective governance mechanisms at the district level play a conspicuous role in enhancing local awareness and managerial capacity of supply-side stakeholders*.

On the allotted date, the HCFs' regular pharmacists need to visit the DDWs and physically verify the dispatch quantity before receipt. DDWs aimed to distribute up to 25% of annual requirement for each quarter. However, the gross proportion and the frequency of dispatch depended on the quantity of medicines available at the DDWs and HCFs. The supply quantity allocated for each quarter is designated as 'compulsory issue,' while the distribution of additional units exceeding the quarterly allocation is categorized as 'normal issue.' It was reported that *DDMS has an in-built feature to apportion the quantity of units to be dispatched based on the batch, consumption pattern, annual indent, and stock at the DDW and HCF concerned*.

However, while executing normal issues, the DDW personnel apply their judgment to ensure that the issued quantity does not exceed the total annual indent submitted by the HCFs. *Tables 38 and 39* show the average quantity of annual indent fulfilled across all quarters of FY 22-23, and their sources as per DDMS records of HCFs.

Table 38: Average quantity of annual indents received from KMSCL across the financial quarters of FY 22-23

Quantity received per quarter	Q1	Q2	Q3	Q4
	Average indent quantity fulfilled per quarter (%) (95% CI)			
Idukki	13.65 (12.13, 15.16)	20.41 (17.49, 23.33)	27.03 (24.75, 29.31)	27.42 (24.46, 60.37)
Kozhikode	24.19 (17.82, 30.40)	28.25 (26.10, 30.40)	20.91 (12.98, 28.84)	18.98 (17.74, 20.23)
Palakkad	20.53 (15.89, 25.16)	21.72 (17.35, 26.09)	28.41 (27.58, 29.25)	25.77 (24.43, 27.10)
Thiruvanan-thapuram	14.43 (13.92, 14.94)	21.64 (18.65, 24.64)	30.12 (28.23, 32.02)	17.88 (16.94, 18.82)
Thrissur	10.56 (8.51, 12.62)	20.49 (18.12, 22.86)	27.55 (25.22, 29.87)	21.38 (18.23, 24.52)
HCFs				
DH/GH	12.03 (9.48, 14.58)	28.52 (22.61, 34.42)	30.45 (22.67, 38.23)	24.63 (20.70, 28.55)
TH/THQH	11.42 (8.3, 14.52)	22.26 (17.74, 26.77)	28.06 (21.62, 34.50)	22.81 (16.13, 29.49)
CHC/ BPHC	17.07 (8.88, 25.26)	27.37 (24.81, 29.94)	29.60 (27.44, 31.77)	23.8 (20.50, 27.09)
AAM-PHC	17.09 (13.38, 20.80)	21.03 (18.70, 23.37)	26.09 (22.51, 29.67)	21.21 (18.71, 23.71)
Pooled	**16.59** (13.81, 19.37)	**22.48** (20.38,24.58)	**26.98** (24.20, 29.77)	**21.88** (20.08, 23.69)

**To note, the data does not include the units procured locally or received from other facilities.*

Table 39: Average quantity of annual indent fulfilled by KMSCL and Other Sources

Receipt Sources	KMSCL	Others	Total (FY 22-23)
	Average receipt per annum % (95% CI)		
Idukki	98.47 (94.70, 102.23)	15.79 (8.69, 22.88)	114.25 (104.24, 124.26)
Kozhikode	96.63 (87.40, 105.85)	20.25 (11.33, 29.17)	116.88 (99.00, 134.76)
Palakkad	97.25 (95.79, 98.70)	3.79 (1.96, 5.63)	101.04 (98.78, 103.30)
Thiruvananthapuram	100.62 (93.87, 107.36)	20.01 (15.04, 24.98)	120.62 (117.96, 123.29)
Thrissur	79.16 (75.06, 83.25)	22.71 (17.43, 27.98)	101.86 (94.76, 108.97)
HCFs			
DH/GH	101.14 (94.61, 107.68)	5.52 (1.08, 9.97)	106.67 (98.20, 115.14)
TH/THQH	99.92 (96.87, 102.98)	20.83 (5.94, 35.71)	120.75 (107.67, 133.83)
CHC/ BPHC	91.68 (80.36, 103.01)	8.19 (3.76, 12.62)	99.87 (88.00, 111.75)
AAM-PHC	93.35 (85.78, 100.93)	18.76 (12.49, 25.04)	112.12 (103.45, 120.78)
Pooled	**93.66** (88.10, 99.23)	**16.60** (11.91, 21.30)	**110.27** (103.36, 117.17)

**Others include local purchases; inter-facility transfers and NHM schemes*

KMSCL is responsible for the logistics management up to the level of AAM-PHCs, and recently the Janagiya Arogya Kendram (formerly known as HWCs). The agency facilitates the logistics of indented supplies, and NHM projects to the facilities but not the State-specific projects (e.g. allocation under palliative care, renal diseases, or extreme poverty). In case of emergencies, the HCFs can arrange for their own transport vehicles to collect the medicines from the DDWs. Reverse logistics of dead-stock need to be done by the HCFs as per the allotted dates.

Inter-facility transfers are handled by private logistics service providers, with the costs borne by the HMC of the receiving HCF. However, *this arrangement was reported as a challenge in Idukki due to the difficult terrain and the high tariffs imposed based on weight and distance*.

Each DDW was earlier allotted two vehicles for logistics. *At the time of assessment, all transport vehicles owned by KMSCL were condemned by government orders*, as they had been in service for over 15 years. For over a year, both KMSCL and HCFs have been managing logistics by either utilizing hired vehicles or streamlining transport arrangements from other programs.

Due to the contracting of transport providers, drivers, and loading staff for logistics, the DDWs reportedly faced significant operational costs, including Rs 70,000 to Rs 80,000 per month for transportation and up to Rs 1.5 Lakhs per month for payments to loading staff affiliated with the Indian Workers Trade Union. To mitigate transportation costs and reduce lead times, some districts reported coordination between DDWs and HCFs to enable *pooled distribution*.

Transport vehicle

Alternatively, the HCFs managed logistics by either using their own vehicles, such as palliative care vehicles or ambulances, or hiring pick-up vehicles and loading staff funded through LSGD or HMC resources. However, when the vehicles arranged by HCFs lacked sufficient capacity to accommodate the allotted medicines for dispatch, they had to visit the DDWs multiple times within a month.

Overall, the distribution frequency was observed to be at least twice per quarter and exceeded ten times annually in some facilities. Factors such as the timely and complete supply of medicines to DDWs by vendors, the consumption rate at HCFs, storage limitations at HCFs, the time required for receipt verification by institutional pharmacists, and transport availability or constraints reportedly influenced the distribution frequency each quarter. *Despite practical constraints, the stakeholders' collaborative approach significantly streamlined distribution and logistics*.

INVENTORY MANAGEMENT

The DDWs had *state-of-the-art facilities with commensurate storage capacity, specialized equipment* (loading docks, forklifts), *infrastructure* (walk-in cooler, cold-storage, dedicated floors for medicines), *and adequate safety and security features*. The inventory management at the DDWs was noticeably robust. However, each DDW had a substantial amount of accumulated deadstock due to prolonged delay in their condemnation.

Given the alignment of the procurement cycle with the financial year cycle, the study assessed the average balance stock available at the facilities towards the end of the FY 22-23. The data provides insights on the ability of KMSCL to meet the demand while transitioning to next financial year. The estimates *(See Table 40)* show seemingly sufficient inventory to meet the district-wide demands for a month. However, the availability varied for each tracer medicine *(Figure 19)*. The stock of NCD medicines was mostly depleted due to their high turnover, whereas Salbutamol's availability surpassed others owing to reported delays in its supply during FY 2022-23.

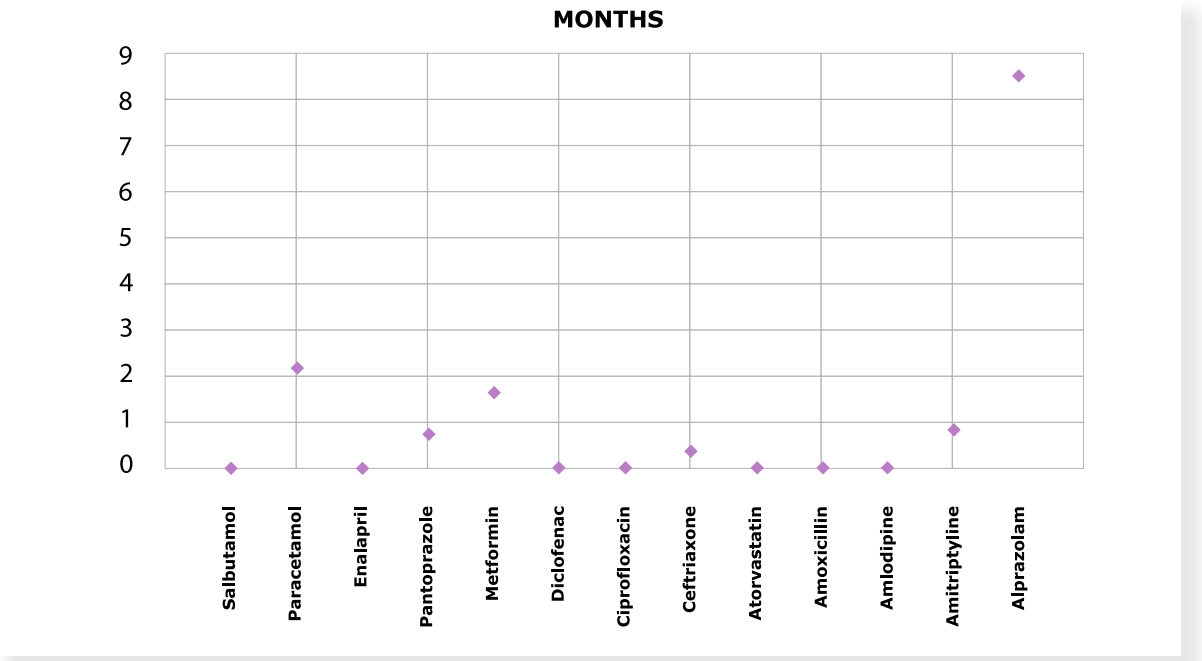
Interestingly, the data for FY 2022-23 aligns with field observations from Palakkad in April 2024, where most facilities reported stockouts of certain tracer medicines due to their unavailability at the DDW. This suggests that the *deficit situation exhibits a recurring temporal pattern*. The deficits may stem from the rigidity of the annual procurement plan aligned with the financial year cycle. To elaborate, KMSCL has reportedly set safety stock levels for each medicine based on consumption patterns. When stocks fall below these thresholds, IWTs are initiated. However, challenges arise when multiple DDWs simultaneously report deficits of specific medicines. Given that such shortages are often reported and anticipated during the transition phase (January to April), it is crucial to strengthen buffer stock and safety levels maintained by DDWs and HCFs across financial cycles.

Table 40: Mean balance stock at the DDWs towards the end of the FY 22-23 with respect to average monthly consumption

Districts	Months	LSE	95% CI	
Idukki	1.24	0.49	0.26	2.22
Kozhikode	1.18	1.39	-1.60*	3.96
Palakkad	1.76	1.30	-0.84*	4.35
Thiruvananthapuram	0.05	0.46	-0.87*	0.97
Thrissur	<0.05	0.45	-0.96*	0.85

**The practical lower bound of the confidence interval should be interpreted as zero. It has been generated due to some observations being closer to zero.*

Figure 19: Mean balance stock (in months) of each tracer medicine at the DDWs towards the end of the FY 22-23 with respect to average monthly consumption



STOCK MANAGEMENT

The State-wide efforts to upgrade HCFs and modernize their stores and pharmacies are exemplary. However, with the rising demand and increasing inventory at these facilities, there is a need to reassess the sufficiency of existing spatial allocations and storage systems . It would enhance the efficiency of operations while improving both storage conditions and the overall work environment.

The accuracy of the stock reported in the records were verified physically for the assessment. The verification could be completed in 49 out of 50 facilities. To fulfill the study's requirement, this component utilized data from DDMS. The stock-accuracy with respect to its reporting is shown in *Table 41* and *Figure 20*. The excess physical stock compared to reported units was primarily attributed to spatial constraints and infrastructural limitations that hindered the segregation of issued stock from main stock. Furthermore, delays in updating digital records and the excessive workload at pharmacies also impacted stock management and record maintenance. Additional factors contributing to stock inaccuracies included:

Infrastructure for stock management

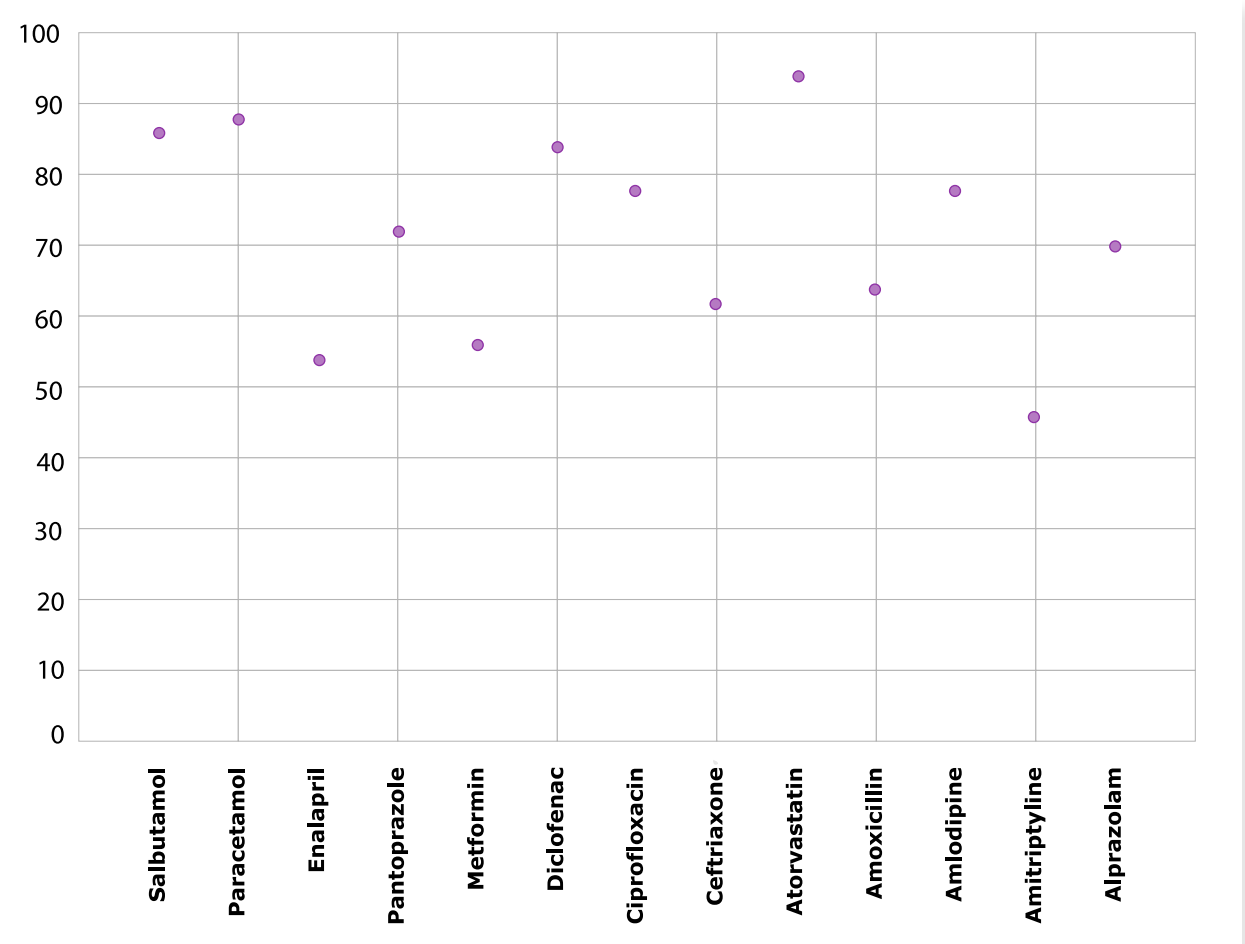
- Unclear documentation of supply quantities under NHM.
- Discrepancies between local purchase invoice data entered into DDMS and the actual units received.
- Unnoticed changes in the 'Freeze' memos of medicines.
- The inability to trace stock quantities during site visits.

Space constraints

Table 41: Stock accuracy – Districts, HCFs, Pooled

Districts	Median	IQR	Min	Max
Idukki	99.97	5.25	95.29	167.03
Kozhikode	99.90	6.42	76.97	132.79
Palakkad	99.93	1.47	78.18	106.51
Thiruvananthapuram	100.00	1.20	87.28	101.32
Thrissur	99.53	3.58	85.35	173.67
HCFs				
DH/GH	99.94	1.90	95.29	102.27
TH/THQH	100.94	2.68	99.94	106.51
CHC/ BPHC	99.92	1.91	97.03	132.79
AAM-PHC	99.87	4.32	76.97	173.67
Pooled	**99.94**	**2.84**	**76.97**	**173.67**

Figure 20: 100%Accuracy in Reported and Available Stock– Tracer Medicine-wise



In general, stock accuracies were notably higher for Habit Forming Medicines used in mental health services, as well as injection vials across facilities. In adherence to State orders, most facilities rigorously monitored the movement of costly medicines, including habit-forming substances and injections. The implementation of a double-locker system, observed in many facilities, further supported accurate stock management. However, stock accuracies for high-volume and fast-moving medicines require attention.

Double locker, Habit forming drugs and Injection storage space

DDMS features an in-built notification system to alert users about near-expiry medicines. To minimize wastage, store custodians and institutional heads coordinate inter-facility transfers to HCFs with immediate needs or faster turnover for the same medicines. Consequently, minimal wastage of tracer medicines was documented at HCFs during FY 2022-23, with any wastage attributed to quality failures rather than expiration *(Table 42)*. These inter-facilities and DDW transfers played a crucial role in preventing prolonged stock shortages, surpluses, or wastage, exemplifying a key SCM flexibility leveraged by HCFs.

Table 42: Units of unusable stock at the HCFs for the FY 22-23

Tracer Medicines	Proportion*	SD	Min	Max
Ciprofloxacin (n=2)	80.77	27.20	61.54	100.00
Alprazolam (n=4)	65.00	42.23	15.00	100.00
Paracetamol (n=3)	20.08	8.38	13.95	29.63

**Proportion of wasted units out total units of the specific tracer medicine received by the HCF*

STOCK AVAILABILITY

The primary objective of the SCM activities is to ensure the consistent availability of essential medicines at HCFs, enabling uninterrupted and responsive service delivery. The study evaluated stock availability on the day of assessment, stockout rates, and cumulative stockout days during the assessment period (FY 2022-23).

Store rooms

Stockout Rate on the Day of Assessment

Stockouts of tracer medicines were most frequently observed at the AAM, particularly in Palakkad *(Table 43)*. As noted earlier, this may be attributed to the timing of the visit, when both the DDWs and HCFs were experiencing supply shortages. Common factors contributing to stockout episodes included the complete utilization of indented stock, delays in stock receipt, and inadequate supply from the DDWs. *Table 44* shows the proportion of sampled HCFs reporting stock out of each tracer medicines on the day of assessment.

Table 43: Stockout rate on the day of assessment (%)

District	Mean	LSE	95% CI	
Idukki	7.97	0.85	6.15	9.79
Kozhikode	13.79	1.48	10.65	16.94
Palakkad	34.00	3.62	26.28	41.71
Thiruvananthapuram	14.79	1.66	11.24	18.33
Thrissur	7.75	1.53	4.49	11.01

District	Mean	LSE	95% CI	
HCFs				
DH/GH	4.90	2.12	0.39	9.40
TH/THQH	7.94	3.93	-0.43	16.31
CHC/ BPHC	12.41	3.66	4.61	20.21
AAM-PHC	18.40	4.17	9.51	27.29
Pooled	**16.26**	**3.04**	**9.78**	**22.73**

Table 44: Percentage of HCFs reporting stock-out of tracer medicines on the day of assessment

Tracer Medicines	% of HCFs (N=49)	LSE	95% CI	
Alprazolam	26.75	8.06	13.19	46.75
Amitriptyline	28.78	5.01	19.36	40.48
Amlodipine	1.72	1.46	0.28	9.92
Amoxicillin	15.71	4.41	8.40	27.48
Atorvastatin	17.11	3.92	10.27	27.13
Inj. Ceftriaxone	1.51	1.28	0.23	9.24
Ciprofloxacin	23.05	6.10	12.58	38.39
Diclofenac	26.49	6.24	15.40	41.64
Enalapril	9.35	4.62	3.13	24.81
Metformin	4.63	2.52	1.42	14.06
Pantoprazole	30.88	8.77	15.69	51.76
Paracetamol	1.72	1.50	0.26	10.41
Salbutamol	11.46	4.84	4.47	26.35

Stock Availability During the Assessment Period

The study aimed to evaluate the number of stockout episodes (n) during the assessment period (FY 2022-23) and the cumulative days without medicine stocks (min-max) as a proxy for stock availability. However, this data was available from only 8 out of 50 facilities (16%). The mean stockout rate during the period was 18.25%, with min-max estimates ranging from 10.71% to 27.78%. Additionally, the cumulative stockout days were retrievable from just 4 out of 50 facilities (8%), with estimates ranging from 12 to 209 days.

Although HCFs meticulously tracked the movement of 'Costly Medicines' and 'Habit Forming Drugs,' the study was unable to retrieve data for both costly and non-costly medicines in a format conducive to analysis. The physical sub-stock register formats

Stock registers

varied significantly and predominantly followed a '*user-centric dispensing log*' approach, which posed considerable challenges in aggregating consumption records for each tracer medicine. Data from a few facilities, however, revealed the prevalence of stockout episodes during the assessment period, some of which extended beyond the financial year cycle. The estimates presented are conservative and restricted to FY 2022-23 (up to March 31, 2023). *While user-centric dispensing logs offer some benefits for patient identification and accountability, they are ineffective for aggregating medicine consumption data*. Comprehensive tracking of stock availability at HCFs throughout the year requires attention until the e-Health Pharmacy module is fully streamlined.

MEDICINE AVAILABILITY FOR THE END-USERS

The assessment involved interactions with users of the sampled HCFs to evaluate the alignment between the medicines supplied and the patients' needs

Respondent Characteristics

Table 45: Respondent Characteristics – End-Usersassessment

No. of Respondents		Presenting Conditions at HCFs (%)*					Respondents with >1 presenting condition (%)	Services availed (%)	
		MNN	CD/ ID	NCD	Injuries	Others	Multiple conditions	Consultation & medicines	Only medicines
Districts	N (%)						N=23	N = 211	N = 30
Idukki	38 (15.77)	2.63	50	36.84	0	10.53	18.42	92.11	7.89
Kozhikode	48 (19.92)	6.25	22.92	54.17	2.08	14.58	8.33	87.5	12.5
Palakkad	60 (24.9)	0	21.67	41.67	8.33	28.33	5	90	10
Thiruvan-anthapuram	68 (28.22)	0	42.65	47.06	2.94	7.35	8.82	85.29	14.71
Thrissur	27 (11.2)	0	48.15	29.63	7.41	14.81	11.11	81.48	18.52

No. of Respondents		Presenting Conditions at HCFs (%)*					Respondents with >1 presenting condition (%)	Services availed (%)	
HCFs									
DH/GH	20 (8.30)	0	25	40	20	15	0	90	10
TH/THQH	29 (12.03)	0	31.03	34.48	6.9	27.59	3.45	93.1	6.9
CHC/ BPHC	44 (18.26)	2.27	47.73	29.55	4.55	15.91	6.82	88.64	11.36
AAM-PHC	148 (61.41)	2.03	33.78	50	1.35	12.84	12.84	85.81	14.19
Pooled	**241 (100)**	**1.66**	**35.27**	**43.57**	**4.15**	**15.35**	**9.54**	**87.55**	**12.45**

**MNN – Maternal, Neonatal and Nutrition; CD/ID – Communicable/Infectious Disease; NCD – Non-Communicable Diseases*

Most OPD users who participated in exit interviews reported visiting HCFs for NCD management or treatment of minor ailments, including communicable and infectious diseases. Those who accessed the facilities solely for medicines were primarily users empaneled for monthly follow-ups or referred to the facilities for prescription fulfillment.

Users

Availability of Medicines on the Day of Visit

The users' prescription slips were reviewed during interactions to document the number and quantity of medicines prescribed and dispensed. *Table 46* presents the prescription fulfillment status on the day of the assessment. Out of 241 respondents

interviewed, 7 from Kozhikode and Palakkad reported not receiving any medicines. However, all respondents confirmed that the medicines they received were provided free of cost. *Table 47* highlights the main reasons for incomplete or nil prescription fulfillment.

Table 46: Mean percentage of medicines received as prescribed to the users

	Mean	SE	95% CI	
Presenting Conditions				
MNN	56.25	25.77	5.49	107.01
CD/ID	87.21	1.98	83.31	91.10
NCD	81.86	2.32	77.29	86.42
Injuries	88.83	3.81	81.33	96.34
Others	80.17	4.76	70.80	89.54
Districts				
Idukki	85.44	3.06	79.40	91.47
Kozhikode	85.59	3.24	79.22	91.97
Palakkad	76.57	4.05	68.61	84.54
Thiruvananthapuram	85.75	2.38	81.06	90.44
Thrissur	85.43	3.12	79.29	91.57
HCFs				
DH/GH	84.25	5.43	73.56	94.94
TH/THQH	77.41	4.12	69.31	85.52
CHC/ BPHC	84.35	3.04	78.37	90.33
AAM-PHC	84.09	2.01	80.14	88.04
Pooled	**83.35**	**1.51**	**80.38**	**86.31**

Table 47: Reasons for nil or incomplete prescription fulfilment

Reasons	Not in stock	Outside EDL	Shortfall	Operational reasons*
Kozhikode	72.22	11.11	5.56	11.11
Palakkad	95.83	4.17	0	0
Thrissur	84.62	15.38	0	0
Idukki	100	0	0	0
Thiruvananthapuram	76.67	20	3.33	0

Reasons	Not in stock	Outside EDL	Shortfall	Operational reasons*
HCFs				
DH/GH	62.5	25	12.5	0
TH/THQH	77.78	22.22	0	0
CHC/ BPHC	89.47	0	0	10.53
AAM-PHC	89.29	8.93	1.79	0
Pooled	**85.15**	**10.89**	**1.98**	**1.98**

**Operation reasons include accessing HCFs post-OPD hours or re-direction to lower level HCFs for fulfilling the prescriptions.*

Observational Findings

Medicine availability to end-users showed significant temporal variation, largely driven by the procurement cycle. This factor accounts for the lower prescription fulfillment recorded in Palakkad district compared to other regions *(Tables 46 & 47)*.

Non-availability due to geographic/spatial variations was not discernible across the districts, indicating the existence of reasonable *equity-safeguards* in the State's Supply Chain System. While HCFs across districts commonly emphasized the need for expanded financial allocations, *it is noteworthy that facilities in remote or challenging terrains received allocations proportional to their catchment requirements.* These facilities also depended less on LSGD funds, as KMSCL fulfilled most of their needs. Furthermore, as mentioned earlier, awareness of demographic patterns, geographic accessibility, and fluctuating demand enables DDW personnel to strategically plan distribution schedules and route maps, ensuring equitable supply access within districts.

Provider and user interactions revealed that population empanelment to AAM-PHCs functions effectively as a *gatekeeping mechanism* when systematically implemented. Some NCD patients accessing secondary and tertiary HCFs reported only partial fulfillment of their prescriptions. Providers at secondary HCFs explained that this was a deliberate measure to dissuade users from repeatedly utilizing their pharmacy services for follow-ups and to redirect them to the linked AAM-PHCs for continued pharmaceutical care. This practice was driven by financial logic, as AAM-PHCs indent NCD medicines based on the line-list of their catchment population, while secondary HCFs base their indents on estimated OPD footfall. Re-routing NCD patients to AAM-PHCs aimed to prevent undue depletion or wastage of medicine supplies. For instance, an AAM-PHC in Thrissur, located near an MCH, reported cases where NCD patients who primarily accessed the MCH preferred using this AAM for prescription fulfillment rather than their panchayat's AAM. To ensure continuity of care, the line-lists for these specific individuals were transferred to this center.

However, this approach occasionally left some user needs unmet, particularly for those opting to access secondary HCFs. Users often cited medicine unavailability and reluctance to use their local AAM-PHCs as reasons for turning to higher-level HCFs.

An additional observation was that physicians occasionally prescribed branded or combination medicines that were outside the EDL of AAM-PHCs. This was sometimes done to facilitate purchases from private providers, based on specific medical needs (e.g., Chymoral Forte for trauma management). Pharmacists at AAM-PHCs were able to provide only the generic equivalents of branded medicines. However, combination medicines or those not listed in the EDL were unavailable, requiring users to obtain them from alternative sources such as Jan Aushadhi, KCP, Neeti Stores, or private outlets.

Prescription practices in the State were quite variable. While supervisory authorities have directed in-house teams to conduct routine prescription audits, *there is a pressing need to streamline the frequency of these audits and ensure the integration of corrective actions based on audit findings*. The differential implementation of the e-Health project resulted in HCFs issuing both hand-written and printed prescriptions. Completeness and legibility of hand-written prescriptions need attention, given the clarity offered by printed ones.

In some HCFs, handwritten prescriptions were retained if the entire prescription had been fulfilled, while in others, e-prescriptions were not printed due to shortages of paper or prescription slips. *Addressing the root causes of these practices is crucial, as ensuring that all patients consistently receive a physical, legible copy of their prescriptions is fundamental to medication safety and care continuity*. Despite these challenges, most HCFs supplemented clear verbal instructions for drug administration with written guidance on medication envelopes, aiding patients in following their prescribed regimens effectively.

While most users accessed medicines free-of-cost at the HCFs, instances of non-availability required users to either revisit the facilities at a later date to fulfill their prescriptions or incur out-of-pocket expenses to procure the required medicines. Commonly unavailable medicines included certain NCD medications—such as insulin, anti-hypertensives, anti-hyperlipidemic, and bronchodilators—as well as cough syrups, especially for pediatric users. Additionally, users were observed to incur out-of-pocket expenses to purchase plastic bottles for collecting expectorant syrups dispensed by the pharmacies at sampled HCFs

Availability of Medicines During the Last Visit to the HCFs

Among the 241 respondents, 224 had accessed the same HCFs within the six months preceding the survey. During their last visit, over half of them reported receiving all medicines as prescribed. However, a significant proportion reported only partial fulfillment of their prescriptions *(Table 48)*. The reasons for nil or partial fulfillment during their previous visit were consistent with those observed on the day of the assessment.

Table 48: Report of prescription fulfillment during the last visit (%)

Prescription Fulfilment	Not fulfilled	Partially fulfilled	Completely fulfilled
Districts			
Idukki (n=36; 94.74)	5.56	44.44	50
Kozhikode (n=44; 91.67)	0	52.27	47.73
Palakkad (n=56; 93.33)	0.00	36.21	63.79
Thiruvananthapuram (n=61; 89.71)	1.64	39.34	59.02
Thrissur (n=27; 100)	0.00	70.37	29.63
HCFs			
DH/GH (n=19; 95)	5.26	31.58	63.16
TH/THQH (n=27; 93.10)	0.00	64.29	35.71
CHC/ BPHC (n= 41; 93.18)	0.00	53.66	46.34
AAM-PHC (n=137; 92.57)	1.45	41.30	57.25
Pooled (n=224; 92.95)	**1.33**	**45.58**	**53.1**

**Operation reasons include accessing HCFs post-OPD hours or re-direction to lower level HCFs for fulfilling the prescriptions.*

Satisfaction with Quality

Users who received medicines from HCFs were asked about their satisfaction with the quality of medicines dispensed. From their perspective, quality encompassed various aspects tied to meeting individual expectations. These included 'relief' from ailments or pain following medication use, 'adequate control' of chronic conditions like COPD and diabetes, 'availability of medicines,' 'short waiting times' for accessing medicines, and complete 'prescription fulfillment,' which helped avoid additional trips to other hospitals or pharmacies. When these expectations were not met, patients expressed dissatisfaction. *(See Table 49)*.

Table 49: User responses (%) – Satisfaction towards quality of medicines

User Response	Satisfied	Not Satisfied	Other responses
Districts			
Idukki	86.11	2.78	11.11
Kozhikode	93.18	2.27	5
Palakkad	98.21	0	1.79
Thiruvananthapuram	80.33	3.28	16.39
Thrissur	92.59	0	7.41
HCFs			
DH/GH	94.74	0.00	5.26
TH/THQH	77.78	7.41	14.81
CHC/ BPHC	92.68	0.00	7.32
AAM-PHC	90.51	1.46	8.03
Pooled	**89.73**	**1.79**	**8.48**

**Operation reasons include accessing HCFs post-OPD hours or re-direction to lower level HCFs for fulfilling the prescriptions.*

A couple of users reported receiving 'fragmented tablets', indicating gaps in storage practices. This was also observed by the data collection team in one of HCFs in Kozhikode.

Some users reported procuring medicines from both public and private HCFs, either due to their unavailability at the HCFs or based on individual preferences. However, there were no discernible patterns in user satisfaction responses that could be attributed to specific types of medicines.

Overall, the HCFs were found to effectively meet patient needs. *Most users expressed appreciation for the free-of-cost medicines provided and their quality. Vulnerable groups*, such as BPL and Palliative Care beneficiaries, *reported receiving complete and free access to medicines*. The State has already established mechanisms to ensure equity in supply distribution, medicine availability, and robust governance for pharmacy operations to optimize resource utilization, uphold patient safety, and maintain care standards. By addressing existing implementation gaps, the State can further strengthen its internal operational standards and enhance overall system-wide efficiency.

ENABLERS AND BARRIERS

The Supply Chain Management system in Kerala serves as an exemplary adaptation of the pioneering TNMSC model, meticulously tailored to address the State's unique context. By prioritizing health as a key developmental initiative, the system has fostered robust convergence, significantly enhancing its flexibility and agility. Nevertheless, certain aspects of the existing framework present opportunities for further improvement to optimize its overall efficiency.

Key Enablers of the SCM System

- When Kerala's SCM model is analysed within its context, it becomes evident that its unique strengths stem from the overall health systems strengthening efforts led by the Department of Health and Family Welfare, adequately supported by Local Self-Governing Departments and other line departments. *A satisfactory internal standard of performance is maintained due to the presence of necessary health systems inputs and clearly defined, streamlined processes*, which are also reflected in the overall SCM of medicines.
- Strategic infrastructural investments made by the Directorate of Health Services and the State Digital Health Mission have enabled an ICT-driven SCM model in the State. *These forward-looking investments have been vital to addressing contextual factors contributing to supply chain failures, such as climatic conditions or challenging terrains*. Notable strengths of Kerala's IT-enabled SCM model include *pharmacy modernization and extensive, secure internet connectivity achieved through government initiatives*.
- The DDMS has established itself as a forerunner in the universal adoption of ICT platforms for SCM. *The positive sentiment and demonstrated workflow enhancements associated with DDMS are expected to ease the transition and foster broader acceptance of e-Health initiatives for hospital workflows*. For instance, the gradual implementation of barcoded outpatient tickets, UHIDs / ABHA IDs, and prescription sheets under the e-Health project is a promising step toward accurate service delivery and continuity of care across the referral chain.
- The establishment of Karunya Community Pharmacies under KMSCL and linking them with public HCFs provides essential flexibility, *improving access to affordable medicines for both healthcare facilities and the general population*.
- The State's Human Resources for Health strategy stands out for its *interdependence with the health department, LSGDs, the National Health Mission, and Hospital Management Committees*. Best practices include clearly defined roles and responsibilities, HR placement based on operational hour requirements, and leveraging nodal institutes (SIHFW and SHSRC) and an online learning management system to impart SCM-related skills.
- The efficiency and adaptability of the SCM system are largely attributable to the *commitment of regularly posted cadres across the supply chain and contractually hired DDW staff*. Their prolonged engagement with the organization, contextual

awareness, and commendable working relationships with stakeholders play a pivotal role.

- The State's success in universalizing an IT-enabled SCM mode is primarily rooted in *robust governance practices*. Kerala's SCM governance framework is *well-defined and considered one of the best in the country. Every initiative aligns with corresponding guidance notes issued by the State, which clearly outline the roles of DHFW stakeholders and their liaisons with HCFs*. Furthermore, the effective implementation of governance mechanisms across supply chain stakeholders has fostered a social-value system, while also promoting coordination and the development of contextually aligned managerial and technical capacities among the stakeholders.
- The DDMS-driven indenting process facilitates *data-driven resource allocation and procurement decisions*, emphasizing the importance of a longitudinal database for appraisals and course corrections.
- The dual-pronged procurement approach—via KMSCL and local purchases—exhibits significant strengths. LSGDs empower HCFs to make local purchases for emergencies, adding agility to the supply chain. This enables quick responses to unexpected shortages or urgent patient requirements. *Supervisory oversight of local purchases disincentives resource wastage, and centralized payment processing for local purchases promotes greater accountability*.
- The policy mandating priority for not-for-profit (often governmental) entities in local purchases strategically channels funds to these organizations, ensuring sustainability and fostering local production of medicines and supplies. *This interdependence aligns these entities more closely with the State's public health goals* compared to private for-profit suppliers.
- Similar to the TNMSC model, the State has implemented internal mechanisms, such as inter-warehouse and inter-facility transfers, to manage procurement costs, reduce lead times, balance inventory, and minimize wastage. *Noteworthy collaborations, like emergency purchase transfers between TNMSC and KMSCL, bolster supply chain resilience during unforeseen challenges*.
- Overall, the SCM framework incorporates *equity safeguards and gatekeeping mechanisms to optimize resource allocation, utilization, and value delivery for end users*.

Areas Needing Attention

While Kerala's SCM model strives for efficiency by leveraging the State's unique strengths, addressing the identified implementation gaps will be critical for further enhancing its effectiveness.

- Kerala's efforts in upgrading healthcare facilities' infrastructure and service delivery have significantly improved the supply of healthcare services. However, *the volume of medicines and consumables received and distributed to these facilities now exceeds existing infrastructural capacity, particularly at primary*

level facilities and community health centers. Additionally, the *conduciveness of the work environment for personnel needs urgent attention*, as reports indicate the development of occupational diseases due to infrastructural deficits. The accumulation of dead stock, caused by delays in reverse logistics and condemnation processes, has further exacerbated spatial constraints within the facilities.

- Although the e-Health Project is emerging as a key ICT platform complementing DDMS-driven activities, several practical issues need to be addressed to effectively leverage its Pharmacy module in HCFs. Challenges such as prolonged power outages, network or server latency, real-time calibration of baseline data, high patient case-loads, and the lack of login credentials for contractual MOs have led to concurrent usage of hand-written prescriptions alongside e-prescriptions. While units dispensed through e-prescriptions are auto-deducted from baseline data, those dispensed via paper-based prescriptions are not. These *distortions in real-time data used by MOs misalign prescription practices with actual stock availability, adversely affecting patient access to medicines*.
- The LSGD plays a critical role in HR placement, particularly in remote locations, to address HRH gaps. However, *poor accessibility in some areas can deter HRH entry, perpetuating vacancies*.
- Although the State's gross staff availability exceeds requirements outlined by IPHS, the State's context present compelling evidence for *re-evaluating HRH strategy based on evolving operational requirements for equitable work distribution*. Increased workloads and administrative delays have contributed to inefficiencies in the supply chain and service delivery. Timely training, onboarding orientation, and orientation of pharmacists during transfers to higher-level institutions need attention to ensure seamless operations.
- The indenting process appears sufficient for annual consumption; however, *the lack of actual forecast data is a notable limitation*. Currently, DDMS relies solely on indent reports, under the assumption of a strong correlation between forecast and indent data. This simplification introduces biases into the database used for procurement cycles, partially explaining the reported discrepancies between KMSCL supplies and actual demand.
- *The annual procurement cycle, tied to the financial year timeline, has consistently resulted in recurring stock deficits during the transition months (January to April)*. Addressing these stock deficiencies in the last quarter is crucial for recalibrating the annual indenting process to meet full-year demands.
- *Local purchases through insurance-based reimbursement channels require attention, especially as these channels serve vulnerable populations under benefit schemes*. Field reports indicate that administrative inefficiencies and delays adversely impact patient needs, who are then forced to bear the financial burden of availing medicines.
- Currently, *there is no State policy to allow compensatory indenting for the financial value of medicines declared as 'No Bidder Items' and for partially fulfilled supplies to HCFs* for procuring alternative medicines.

- Logistics management, though being an explicit mandate for KMSCL, has required collaborative efforts involving HCFs, LSGDs, and DDWs for over a year due to the condemnation of previously owned government vehicles. It is necessary to expedite the reinstatement of dedicated vehicles under each DDW to contain operational costs arising from hired services.
- While effective governance mechanisms have eliminated several reporting inefficiencies, manual tracking of non-costly and costly medicines in pharmacies must be addressed until the e-Health implementation is streamlined.
- Prescription practices across the State should be standardized, accounting for the implementation strategies of e-Health and HRH placement to enhance operational efficiency and patient care.

LIMITATIONS

- The analysis of data does not fully adjust for temporal and spatial variations in both States, though they were discernible during the data collection visits. The availability of medicines on the day of assessment was variable across the clusters and financial quarters during which the visits were conducted.
- The attempt to quantify the number of indents raised as per State practices was difficult, given the variability it introduced into the standardized tool. Qualitative explanations have been provided, wherever appropriate, for contextual information.
- A potential limitation of this study is the possibility of anticipatory response bias. After observing the data collection process at initial sites, the district and HCF representatives who accompanied the investigators shared information about the assessment criteria with other participating facilities. This may have allowed these facilities to prepare for the data collection, potentially influencing their responses. This anticipatory preparation could have led to over-estimation of compliance with certain protocols or an under-reporting of challenges faced by the facilities. As a result, the findings should be interpreted with caution, as they may not accurately reflect the typical practices of the participating healthcare facilities. While this effect cannot be controlled, future studies should mitigate opportunities for prior knowledge of the data collection process in bureaucratic systems, while also ensuring data collection feasibility and participation.
- The current study predominantly extracted information from historical records, and data triangulation was done using multiple sources for observational findings to mitigate bias in reporting. Further two of the three data collectors were proficient in the local language. This likely facilitated smoother data collection by improving rapport with respondents and ensuring accurate interpretation of responses, minimizing the risk of miscommunication or loss of meaning in translation. Yet, there is a chance for bias. State officials also acknowledged the likelihood of data entry errors, albeit minimal
- While comparing the SCM practices of each State, it is important to note that differential reporting is attributable to data availability and depth of reporting during stakeholder interactions. Given the analogous operational framework of the State's supply chain models, there is a high possibility that practices not made explicit in a State still exist, even though they were evident in the other State.
- The interpretation of the respondent characteristics derived from the summary of the end-users recruited for the exit interviews should be limited to appreciating the patient-mix. The study does not claim any representativeness to the district or the public HCFs' utilization pattern. Recall bias of medicine-receipt cannot be

excluded.

- End-user interactions were conducted by maintaining user privacy and information confidentiality. However, some of the users were wary of responding to open-ended questions when the district and hospital officials were near their vicinity.

RECOMMENDATIONS

GENERAL

The collective learning from supply chain management models of the States, combined with stakeholder feedback, provides valuable insights for strengthening supply chain activities in the country. Key suggestions for cross-learning in relevant contexts are outlined below:

- Ensuring robustness and standardization of SCM processes at the centralized procurement level is critical. Implementation strategies should emphasize strengthening infrastructure, human resources, governance frameworks, supply chain networks, technology adoption, and operational procedures.
- District Drug Warehouses must adhere to industrial standards for storage capacity, infrastructure, specialized equipment, security, and fire-safety features. States need to mandate the formulation and adherence to protocols for receipt, storage, and issuance of inventory to enhance operational precision, accountability, facilitate tracking, and reduce wastage due to improper management.
- Governance frameworks for all SCM activities should be explicitly detailed, mapping responsibilities and liabilities for each stakeholder. Effective implementation of robust governance mechanisms creates social capital which is essential for supply chain flexibility and agility. Incorporating quality assurance measures and performance standards into governance mechanisms is essential to ensure accountability and efficiency.
- Adequate placement of human resources is vital for seamless SCM operations. HRH appraisal should go beyond population norms to account for operational demands and the scope of activities assigned to personnel. Retention of HRH within the public sector must be prioritized as it is a critical enabler for successful implementation.
- States with centralized systems and warehouses may consider promoting specialized training programs for student doctors and pharmacists to equip them with essential hands-on skills in SCM. Such initiatives can enhance their operational expertise and preparedness for real-world healthcare environments.
- Demand-supply mismatches within supply chains are often attributed to biases in data entered and utilized through ICT platforms. Indented estimates must align closely with actual demand. States are encouraged to identify, document, and address biases that lead to deviations between intended quantities and real requirements.
- Periodic revision of essential medicine lists and consultations with multiple stakeholders are recommended during the finalization of medicines to be procured under general services and specific programs. These practices enhance health

system responsiveness and prevent resource duplication and wastage.

- Procurement strategies significantly impact resource utilization, supply fulfilment, and medicine availability throughout the year. A rolling forecast and procurement strategy, de-linked from the financial year cycle, is effective in averting predictable shortages.
- States with centralized procurement agencies must establish norms, thresholds, and funding sources for local purchases. States to promote transparent processes for meeting emergency demands, and mitigate resource wastage by disincentivizing unnecessary purchases.
- Distribution and logistics management are crucial for supply chain efficiency and require focused attention. Efforts should be made to alleviate the logistical burden on HCFs for supplies from collection hubs.
- Prescription practices are integral to supply chain efficiency. States should standardize prescription norms and institutionalize prescription audits to enhance the quality of care and ensure patient safety.

TAMIL NADU

Tamil Nadu's SCM system is quite matured with commendable operational efficiencies. The State may consider some suggestions to improve the effectiveness of healthcare service delivery.

- While the State has made adequate investments in infrastructure, implementation strategies of digital platforms may be revisited. A phased-wise and structured digitalization strategy may be planned to take full advantage of the benefits generated in the SC and service delivery outcomes. A process-flow approach may be prioritized while rolling out ICT platforms for SCM of medicines instead of a compartmentalized approach that primarily facilitates ease of tracking by designated authorities. It is essential for enhancing interoperability.
- The State may coordinate with relevant departments to ensure robust internet connectivity at the HCFs, if digitalization strategies are envisioned for HCFs.
- Training needs- assessment may be undertaken to close the skill gaps and improve the comprehensiveness and frequencies of the existing capacity-building activities.
- Though the Data Entry Operators (DEOs) posted at the DDWs were skillful in using the DDMS portal, they may be trained on undertaking simpler analyses on tracer items as part of monitoring activities.
- The over-burdening of the pharmacist cadre needs attention. HRH rationalization and deputation, as done for other services, may create resource inefficiency when done for SCM of medicines. The posting of pharmacists for SCM of medicines should be strengthened and expanded to distribute responsibilities among them and offset the undue workload on the regular cadre.
- Given the availability of DDMS, periodic analysis of the fit between forecasted consumption, indented quantity and actual consumption may be undertaken

to understand the effectiveness and responsiveness of the system. By verifying the alignment across these indicators, the State would be able to ensure that the forecasting exercise sufficiently reflects the actual demand.

- The HCFs need to scientifically forecast and systematically document the forecasting exercises while raising indents. Developing databases on digital platforms can aid scientific forecasting of demands and mitigate untoward effects of external factors on service delivery. When implemented at scale, the aggregate data would supplement robust decision-making by the Directorates and TNMSC. This would also improve the responsiveness of HCFs to cater to local demands, and mitigate reactive indenting.
- The healthcare facilities may maintain a standard format for documenting local purchases, specifically due to demand exceeding the passbook allocation. It may be consolidated to refine and strengthen future indenting or forecasting exercises.
- Programmatic changes that could affect routine SCM activities need to be coordinated with the central agency in advance, to ensure successful programme implementation without disruption or appropriation of forecasted supplies to accommodate new programmes.
- A mismatch between the push-pull balance is often noticeable at HCFs, particularly at the primary level facilities. Considering that actual consumption of distributed products happens at the level of HCFs, feedback solicited from HCFs in terms of indenting practices and alignment of order placement to local demands may be obtained and integrated for centralized planning to enhance health system responsiveness.
- The logistics management in distributing supplies needs attention. Investments for transporting supplies is a priority. Operational efficiencies in logistics may be enhanced through route-planning and pooled distribution, as practiced by other States.
- The State's MTM scheme, which targets a door-to door distribution of NCD medicines, highlights the ongoing multiplication of healthcare delivery sites. This warrants an assessment of the supply network changes that are adopted (planned or organic), and their impact on the overall SCM processes.
- The prevalent prescription practices need to be standardized and streamlined. Prescription audit guidelines may be referred for provider orientation. Dedicated investments may be ear-marked to procure and standardize prescription slips across the facilities. Prescription audits need to be routinized to improve the existing practices.
- The practice of prescription retrieval may be replaced with other data capture mechanisms. Dedicated funds may be allotted to ensure the availability and use of covers /envelopes for dispensing medicines. It may be used for providing written instructions.
- The goal of ensuring access to free medicines must be adequately supported with the issuance of the right quantity to the users. The State needs to take cognizance

of unscientific prescription practices and rationalization of units in the light of patient safety. HCFs may need more medicines than they could justify through consumption records, as the additional consumption made possible through these adjustments cannot be quantified. Internal practices within the facilities in managing supplies may be strengthened through adequate capacity-building and orientation.

KERALA

Kerala's SCM system is distinguished by its unique and efficient practices, fostering cross-learning and adaptation. To further enhance the effectiveness of healthcare service delivery, the following suggestions are proposed:

- Considering the pivotal role of e-Health in hospital workflows and supply chain activities, the State may undertake implementation research to identify enablers and barriers in its deployment. Strengthening the current implementation and refining the rollout strategy will be essential to avert potential challenges while ensuring seamless interoperability between DDMS and the pharmacy module.
- A gap analysis of healthcare facilities' layout, location, spatial capacity, and storage structures is recommended to guide solutions for infrastructure expansion and weather-proofing, wherever necessary. Prospective investments in HCFs should also consider anticipated growth in demand and supply to maintain supply chain efficiency. Exemplary models in facilities such as DH Palakkad and GH Neyyattinkara (Thiruvananthapuram) may serve as references for replication and localized adoption.
- Redefining HRH adequacy in alignment with operational demands and equitable work distribution is critical. With the exponential increase in supply chain activities, it is recommended to evaluate the existing HRH strategy based on the scope and volume of activities performed by personnel responsible for supply chain.
- While contractual pharmacist postings through LSGDs, NHM, or HMC provide interim solutions, prioritizing the placement of a regular cadre is recommended. This strategy is particularly crucial for ensuring HRH availability in remote areas, where even contractual mechanisms struggle to attract personnel.
- Although the State has achieved notable progress in developing a longitudinal demand-and-supply database via DDMS across all care levels, it is suggested that assumptions and methodologies used in forecast generation be regularly reviewed and validated. Additionally, introducing greater flexibility (e.g. recompensing value of NBI items for alternate indenting) to the annual indenting framework could better align procurement decisions with real-time supply and demand needs.
- In addition to the directives issued for prioritizing not-for-profit entities in local purchases, the State may consider establishing purchase conditions for these government-promoted entities. This would ensure their alignment with the overall

SCM goal of guaranteeing medicine availability to end users.

- To address recurring deficit scenarios, the State could implement a rolling forecast and procurement plan that staggers procurement activities throughout the year. De-linking the procurement cycle from the financial year timeline, as practiced by TNMSC, may also help mitigate supply shortages.
- Until the e-Health platform is fully streamlined, HCFs could adopt a medicine-centric dispensing log for effective aggregation and tracking of dispensed medicine units. While the current user-centric format prioritizes patient identification, a medicine-centric approach would facilitate real-time stock monitoring and support better decision-making throughout the year.
- The State should address existing implementation gaps that contribute to variability in prescription practices. Reinforcing guidance for prescription audits and disseminating best practices in e-prescription auditing by some HCF could promote wider adoption.

PROGRAMMATIC IMPLICATIONS

The efficiency of supply chain activities differs inherently between the centralized level and healthcare facilities. At the centralized level, supply chain management is a dedicated function. In contrast, at HCFs, it is just one aspect of a broader spectrum of activities involved in service delivery. Consequently, the potential for implementation challenges increases significantly at the point of service delivery.

A 'health systems' approach to enhancing supply chain management necessitates a comprehensive evaluation of infrastructure, human resources, and key supply chain activities. To improve supply chain activities at the HCF level, States may adapt and integrate the key performance indicators (KPIs) used in this study to conduct a comprehensive assessment of their supply chain. Such an approach allows States to go beyond evaluating their supply chain's performance solely through the 'Stockout rate,' providing a more nuanced understanding and enabling the initiation of system-wide improvement efforts.

The suggested KPIs include:

1. ***Infrastructure:*** *Availability, Functionality, Exclusivity for SCM activities; and appraisal of their adequacy.*
2. ***Digital platforms:*** *Access, functionality, and exclusivity for SCM activities*
3. ***Forecast accuracy:*** *Comparison of a FY's indent with previous FY's recorded consumption (proxy to forecast data).*
4. ***Procurement:*** *Percentage of orders procured through the centralized agency; percentage procured through local purchases*
5. ***Quality compliance:*** *Quantity / value of unusable stock due to quality failure (DDW and HCFs)*
6. ***Warehousing and inventory management:*** *Stock accuracy of physical units against reporting; Quantity and Value of unusable stock due to expiry or damage.*
7. ***Plan in place for a predictable change in demand:*** *Qualitative data*
8. ***Distribution:*** *Quantity of order fulfilled in each indenting cycle (quarter/ annum); quantity of supplies received from sources other than the designated collection hub (i.e. DDW/ Drug Stores)*
9. ***Logistics management:*** *Qualitative data on availability of transport support; frequency and associated costs.*
10. ***Human resources:*** *Availability against State norms and IPHS; turnover rate; vacancy rate; recruitment against vacancy; positions managed through deputation/task-shifting/task-sharing.*
11. ***Record maintenance:*** *Sources maintained (digital, manual, dual); availability of main-stock and sub-stock records*

12. ***Stock availability:*** *On the day of assessment; during the assessment period; and cumulative stockout days for the assessment period.*

Data on these KPIs could be administered for tracer items, including medicines, to enable gap and performance analyses, identify contextual enablers and challenges, and guide preventive and corrective actions.

REFERENCES

1. Resilience capabilities of healthcare supply chain and supportive digital technologies - ScienceDirect [Internet]. [cited 2025 Feb 4];Available from: https://www.sciencedirect.com/science/article/abs/pii/S0160791X22002366
2. Borgström B. Exploring efficiency and effectiveness in the supply chain A conceptual analysis. :13.
3. Bentahar MB and O. Digitalization of the healthcare supply chain: A roadmap to generate benefits and effectively support healthcare delivery | EndNote Click [Internet]. [cited 2025 Feb 6];Available from: https://click.endnote.com/viewer?doi=10.1016%2Fj.techfore.2021.120717&token=WzIzNDM1NDYsIjEwLjEwMTYvai50ZWNoZm9yZS4yMDIx LjEyMDcxNyJdKFpJH3xRrF3Sxow5Uy ngabjV680
4. CHRISTOPHER M. Logistics and Supply Chain Management: Strategies for Reducing Cost and Improving Service (Second Edition) [Internet]. 1999 [cited 2025 Feb 9];Available from: https://www.tandfonline.com/doi/abs/10.1080/13675569908901575
5. Gibson BJ, Mentzer JT, Cook RL. Supply Chain Management: The Pursuit of a Consensus Definition. J Bus Logist 2005;26(2):17–25.
6. Resilient supply chain design under operational and disruption risks considering quantity discount: A case study of pharmaceutical supply chain - ScienceDirect [Internet]. [cited 2025 Feb 9];Available from: https://www.sciencedirect.com/science/article/abs/pii/S0360835218304716
7. Kwon IWG, Kim SH, Martin DG. Healthcare supply chain management; strategic areas for quality and financial improvement. Technol Forecast Soc Change 2016;113:422–8.
8. Tortorella G, Prashar A, Samson D, Kurnia S, Fogliatto FS, Capurro D, et al. Resilience development and digitalization of the healthcare supply chain: an exploratory study in emerging economies. Int J Logist Manag 2023;34(1):130–63.
9. eBooklet on IT Initiatives of NHM.pdf.
10. Free Drugs & Diagnostics Service Initiative :: National Health Mission [Internet]. [cited 2021 Dec 4];Available from: https://nhm.gov.in/index1.php?lang=1&level=2&sublinkid=1218&lid=192
11. Singh PV, Tatambhotla A, Kalvakuntla RR, Chokshi M. Replicating Tamil Nadu's Drug Procurement Model. 2012;(39):4.
12. Hannah E, Basheer N, Dumka N, Kotwal A. Access to medicines in the Indian

Public Health System – what works and what does not? A review of the National Health Mission Common Review Mission Reports (2007-2021). J Glob Health Rep 2023;7:e2023054.

13. Implementation of Online Drugs and Distribution Management Software - Guidelines [Internet]. [cited 2022 Feb 24];Available from: http://www.kgpa.co.in/wp-content/uploads/2021/04/KMSCL-DDMS.pdf

14. Hannah E, Basheer N, Dumka N, Kotwal A. Understanding what really helps to ensure access to diagnostic services in the Indian Public Health System: a realist synthesis of the Common Review Mission reports (2007-2021). J Glob Health Rep 2023;7:e2023035.

15. Tamil Nadu Medical Services Corporation Limited [Internet]. [cited 2022 Mar 10];Available from: https://tnmsc.tn.gov.in/user_pages/drugtender.php?drugcat=T19062

16. Kerala Medical Services Corporation | Dashboard [Internet]. [cited 2025 Feb 11];Available from: https://kmscl.kerala.gov.in/KMSCL/index.php/ckmscl/index/22

17. sara_implementation_guide_chapter2.pdf.

18. Operational Guidelines Free Drugs Service Initiative [Internet]. [cited 2022 Jun 3];Available from: https://nhm.gov.in/New_Updates_2018/NHM_Components/Health_System_Stregthening/Drugs_&_logistics/Operational_Guidelines_Free_Drugs_Service_Initiative.pdf

19. Measuring Supply Chain Performance: Guide to Key Performance Indicators for Public Health Managers. :62.

20. Earp K. USAID Global Health Supply Chain Program Technical Assistance, National Supply Chain Assessment Task Order. :38.

21. KPI Data Collection Form for Data Collected at SDPs, Referral Hospitals, and Warehouses-2018.

22. World Health Organization: Access to essential medicines. [Internet]. [cited 2022 Mar 8];Available from: https://www.who.int/healthinfo/systems/WHO_MBHSS_2010_section4_web.pdf?ua=1

23. National List of Essential Medicines (NLEM), 2022 | Ministry of Health and Family Welfare | GOI [Internet]. [cited 2022 Sep 29];Available from: https://main.mohfw.gov.in/newshighlights-104

24. Common Review Mission (CRM) Reports | National Health Systems Resource Centre [Internet]. [cited 2025 Feb 11];Available from: https://nhsrcindia.org/practice-areas/kmd/common-review-mission-crm-reports

25. Free Diagnostics Service Initiative [Internet]. [cited 2022 Jun 3];Available from: https://nhm.gov.in/New_Updates_2018/NHM_Components/Health_System_Stregthening/Drugs_&_logistics/Free_Diagnostics_Service_Initiative.pdf

26. Ayushman Bharat - Comprehensive Primary Health Care through Health and Wellness Centres: Operational Guidelines [Internet]. [cited 2022 Apr 12];Available from: https://ab-hwc.nhp.gov.in/download/document/45a4ab64b74ab124cfd853ec9a0127e4.pdf

27. Navakeralam Karma Padhathi [Internet]. [cited 2025 Mar 14];Available from: https://nkp.kerala.gov.in/

28. Government of India: National Health Policy 2017 [Internet]. [cited 2022 Apr 20];Available from: https://www.nhp.gov.in/nhpfiles/national_health_policy_2017.pdf

29. Aardram Mission_GO00817a.pdf.

30. Aardram Mission infrast_19092018.pdf.

31. Veena R, Revikumar K, Lekshmi S, Manna P, Mohantha G. Kerala Medical Services Corporation – An Analytical Study on Its Working during the First Three Years of Its Establishment. Res J Pharm Biol Chem Sci

32. G.O.KMSCL-DDMS,2017 [Internet]. [cited 2025 Mar 14];Available from: https://www.kgpa.co.in/wp-content/uploads/2021/04/KMSCL-DDMS.pdf

33. ehealth.pdf.

34. eHealth Kerala [Internet]. [cited 2025 Mar 14];Available from: https://dashboard.ehealth.kerala.gov.in/index.php/Init

35. GO for pharmacists.pdf.

36. Revised duties and responsibilities of staff under pharmacy and medical services wing.pdf.

ANNEXURE 1: KEY PERFORMANCE INDICATORS USED

Activity	Indicator	Formula	Source
Forecasting	1. Forecast Accuracy	1 – (Forecasted requirement – actual consumption) / (Actual consumption) x 100	Central agency, DDW, HCF
Procurement	2. Annual consumption procured through central agency	[No of units procured through central agency / Total no of units procured] x 100	Central agency, DDW, HCF
	3. Annual consumption procured through local purchases	[No of units procured through local purchases/ Total no of units procured] x 100	HCF
	4. Quality Compliance	[Quantity of unusable stock of tracer medicine due to quality failure/ Total quantity of the tracer medicine] x100 [Value of unusable stock of tracer medicine due to quality failure/ Total Value of the tracer medicine] x 100	DDW, HCF
Warehousing and inventory management	5. Stock accuracy	[Total quantity of tracer medicine on digital platform/ Total quantity of the same medicine from physical inventory conducted during a site visit] x 100	HCF
	6. Plan in place for predictable change in demand	N/A Qualitative data	Central agency, DDW, HCF

Activity	Indicator	Formula	Source
	7. Value of unusable stock	[Value of wasted units per commodity due to expiry or damage/ Value of total units of the same product procured] x 100	Central agency, DDW, HCF
Stock management	8. Stock availability on the date of assessment	[Total no of tracer medicines out of stock/ Total no of tracer medicines assessed] *100	HCF
	9. Stock availability on assessment period	No. of stockout episodes during the assessment period for each tracer medicine; min-max cumulative stockout days during the assessment period	HCF
Distribution indicator	10. Indent/ Order fulfilment (direct)	[Quantity of order received for each tracer medicine/ Total order placed for each tracer medicine] x 100	HCF
	11. Indent / Order fulfilment (other sources)	[Quantity of supplies from sources other than the designated collection hub/ Total receipt of the same medicine] [Quantity of supplies received from sources other than the designated suppliers/ Total receipt of the same medicine]	HCF DDW
Infrastructure	12. Available, functional, exclusive	Yes/ No	DDW, HCF

Activity	Indicator	Formula	Source
Human Resource	13. Availability of skilled personnel	[No of filled positions/ Total no of sanctioned positions] x 100	HCF
	14. Skilled personnel turnover rate	[No of personnel left at the end of the FY/ (No of personnel at beginning+ No of personnel at end)/2]	
	15. Vacancy rate	[No of vacant positions/ No of sanctioned positions] * 100	
	16. Recruitment against vacancy	Yes / No	
	17. Sanctioned positions managed through deputation/ task-shifting/ task-sharing	[No of positions managed by interim strategies / No of sanctioned positions] x 100	

ANNEXURE 2: TRACER MEDICINES USED FOR THE ASSESSMENT

Tracer Medicines - Tamil Nadu	Tracer Medicines - Kerala
Amitriptyline Tab IP 25mg	Alprazolam 0.25 mg
Amlodipine Tab IP 5mg	Amitriptyline Tab IP 25mg
Amoxicillin Cap IP 250 mg	Amlodipine Tab IP (film coated) 5 mg
Atorvastatin Tab IP 10 mg	Amoxicillin Cap IP 500 mg
Ciprofloxacin Tab IP 500mg	Atorvastatin Tab IP 10 mg
Diazepam 5mg	Ciprofloxacin Tab IP 500mg
Diclofenac Sodium 50mg	Diclofenac Sodium Tab IP (gastro resistant) 50 mg
Enalapril Maleate Tab IP 2.5mg	Enalapril Maleate Tab IP (film coated) 5 mg
Metformin HCl Sustained Release Tab IP 500 mg	Metformin HCl Sustained Release Tab IP 500 mg
Omeprazole 20mg	Pantoprazole (Gastro Resistant) Tab IP 40 mg
Paracetamol Tab IP 500 mg	Paracetamol Tab IP 500 mg
Salbutamol Sulphate Tab IP 4 mg	Salbutamol Sulphate Tab IP 4 mg
Ceftriaxone Inj. 1gm/Vial	Ceftriaxone Inj. IP 1gm/vial

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