Improving supply chain management of medicines for public healthcare in India

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Abstract

This paper examines the prerequisites for successful drug procurement within the Indian public healthcare system. It argues that the primal objective is timely availability of medicines, and analyses two successful procurement cases, from which four common elements emerge. One, an information system on stocks and flows of medicine. Two, processes and manuals covering the full pipeline of the procurement contract. Three, procedures and work allocation during emergencies. Four, an information system on present and prospective vendors. These elements, coupled with a supply-chain focused mandate on delivery to the end user, and investments in regular training of personnel, enable a public healthcare system that can deliver medicines reliably.

JEL classification: H57, H75, H83, I1, L33, L38

Keywords: Public procurement, public healthcare, medicines, contract management, information monitoring, institutional capacity.

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1 Introduction

The public healthcare system in India was established with the aim to provide preventive and curative healthcare, irrespective of an individual's socio-economic conditions, be it in rural or urban places. However, by all accounts, this system does not function well, with patients choosing to get their medical care from private health care providers (Muralidharan, 2024). In this paper, we build on knowledge from the field of government contracting, and public healthcare policy, to argue that the primary problem is of the lack of certainty in the availability of medicines in the public healthcare system, and that this can be resolved by building better public procurement processes. When public procurement done well, it delivers on three dimensions of outcomes – it is done *within time*, *within cost* and delivers the *correct quality* of what is required. We diagnose public procurement of medicines through the lens of the life-cycle of a contract to identify what is required to improve timely availability of medicines.

Problems with the quality of medicine in the public healthcare system have been previously plentifully documented (Thakur and Thikkavarapu, 2022). There has been much focus on institutional design of the public healthcare system (Chokshi *et al.*, 2016; Pandve and Pandve, 2013), or how the regulation of the health and pharmaceutical industry is broken (Chowdhury *et al.*, 2015). These problems continue to grow despite a continued government interest and investment into developing this sector.

The Indian government expenditure in health increased from 28.6% of total health expenditure in India in 2014, to 40.6% in 2019 (Ministry of Finance, 2024), and was just below 50% out of total health expenditure in India by 2022 (National Health Systems Resource Centre, 2022). Such a growth in expenditure brings the need to conduct a number of public procurement activities: from contracting to build hospitals and primary health care centers, procuring health services of doctors and other healthcare workers, and procuring medical equipment and medicines. Some of these are one-time activities, and others – such as staff and medicine procurement – are continuous procurement activities. State capability to undertake the multitude of these procurement activities is a critical element to deliver prompt and acceptable standards of healthcare to citizens (Kelkar and Shah, 2022).

The diagnostic framework used in this paper is to examine each procurement as a contract between government and a private vendor. Procurement contracting involves four stages as a contract life-cycle: specification of procurement requirement, tendering to award vendor contracts, contract management and closure. Good procurement outcomes are achieved when all four stages are done well. So while Chebolu-Subramanian and Sundarraj (2021) study the problems in the procurement tendering process, we examine the processes involved in all four stages of contracting. This includes the legal framework of public procurement of medicines, the institutions involved with their roles and functions. This helps to identify accountability at different stages of the medicine procurement process that can adversely affect the timely supply of medicines, within the

system up to where the user interfaces with a public healthcare institution. We examine these elements in two cases that are widely regarded as examples of good medicine procurement in India. These are medicine procurement by the Tamil Nadu State Medical Corporation, and under the national anti-Tuberculosis (anti-TB) scheme.

Our analysis identifies the challenge of ensuring predictable availability of medicine within a public healthcare system is that of ensuring a well-functioning supply-chain management system. At the heart of such a system is to have well-defined processes for each stage of contracting. This requires a robust information management system that collects and manages data on the stocks and flows of all medicine product units for robust inventory tracking. The information includes flow of information about supply into the system, as well as about flow out to hospitals, wellness centers, public sector pharmacies and other institutions. These are critical inputs to procurement planning and budgeting. Accurate budgets ensure that payments to suppliers can be readily fulfilled, which incentivises a wider, competitive pool of private vendors to participate in public procurement tenders for medicines.

This information system is also an important resource to better manage and maintain relationships with the marketplace of private suppliers to the public healthcare system. Tracking performance through tests of quality and quantity about deliveries by vendors can help identifying high performance vendors and low performance vendors, which can augment eligibility criteria directly in the tendering process. If information about inventory is made available in advance to private vendors, they can better prepare their production processes to provide adequate supply.

The case-studies have two other common elements related to their medicine procurement processes. Both have well-developed manuals for standards of operations and definitions of process flows. These provide clarity on the roles and responsibilities for various persons involved in the procurement. However, standardised processes and digital information technology systems to manage information flows for better supply chain management within the public healthcare system, is necessary but not sufficient to ensure timely supply to users of this system (Singh *et al.*, 2012). There is need to enhance staff capability through protocols and training, both domain-specific and procurement-specific, in order to reduce shortage of medicines available to the public, which is documented in the institutional framework of the anti-TB scheme.

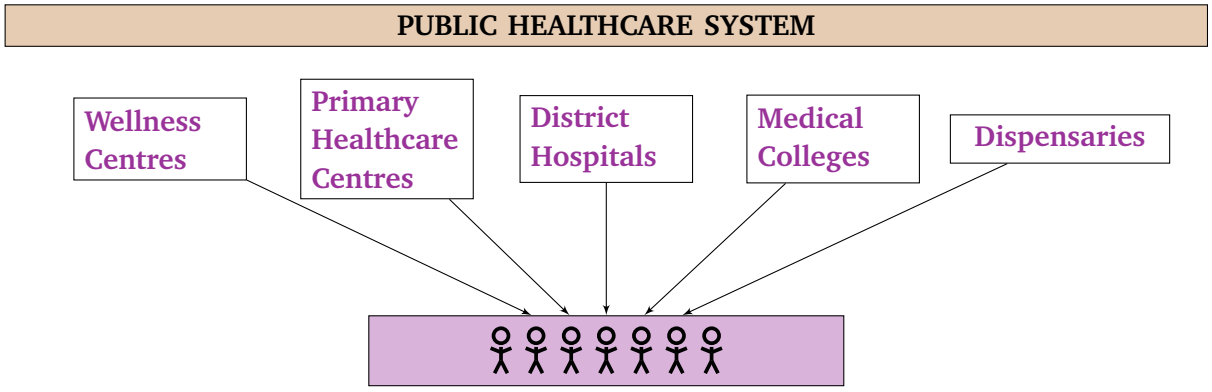
The paper is organised as follows: Section 2 highlights the problems involved when government procures medicines for the public healthcare system in India, why a focus on reducing shortages is a useful path to solving these problems, and our diagnostic approach to do this. Section 3 presents a contract life-cycle approach to evaluate the procurement process for medicines. Section 4 studies how public procurement of medicines is currently done in India. This includes a description of the legal framework (Section 4.1), the institutions (Section 4.2), and case-studies of the Tamil Nadu State Medical Corporation (Section 4.3) and the anti-Tuberculosis scheme (Section 4.4). Recommendations based on these case-studies is presented in Section 5. Section 6 concludes.

2 The importance of public procurement of medicines in India

Healthcare in India has a very large public sector presence.[1] The Constitution of India allocates the power to make laws on the subject of 'Public health' (including hospitals and dispensaries) to the state governments (Entry 6 of List II). However, the subject of 'drugs'[2] is in the Concurrent List, allowing both the Union and state governments to legislate on it (Entry 19 of List III). Subsequently, the Indian public healthcare system that has arisen comprises of several citizen-facing, last-mile delivery institutions, which are collectively referred to as "public healthcare institutions" (PHIs) (Figure 1). These cover Wellness centers, Primary Healthcare centers, District hospitals, Medical colleges and dispensaries. In this system, there are PHIs that are set up by state governments within each state, but some PHIs are set up by the Union government, each of which deliver medical services and medicines to various sections of the population.

Figure 1 Overview of public healthcare institutions (PHIs) in India

The figure below is a representation of the citizen-facing public healthcare system in India. Public healthcare institutions (PHIs) in India have been put in place within districts, based on population, and defined by the Ministry of Health and Family Welfare (MoHFW).
A detailed description of each of these institutions is presented in Table 2 of Appendix A.



Source: Author's compilation from the websites of Union and State governments health departments.

Similar public sector healthcare systems can be found in most countries, where one of the key attractions is that it makes available subsidised medical services and medicines to the public. Public choice theory will lead us to understand that individuals will prefer to access lower cost healthcare from the public healthcare system, but only as long as

[1]The footprint of government public healthcare expenditure increased from 28.6% in 2014 to 40.6% in 2019. See Ministry of Finance, 2023, available at `https://pib.gov.in/PressReleasePage.aspx?PRID=1894902`, last accessed on 19 September 2024. By 2022, the government health expenditure was just below 50% out of total health expenditure in India. See National Health Systems Resource Centre (2022).

[2]Sec. 3(b) of the Drugs and Cosmetics Act, 1940, defines 'drugs' as including both medicines and medical devices.

they are able to access a similar quality and certainty provided by the private healthcare service providers.

Several studies on the performance of the Indian public healthcare system provide evidence of deficiencies. These studies point out to mainly three critical limitations: lack of timely supply of medicines within the PHIs ('shortages'), and poor quality of medicines available at the PHIs, which then triggers broader systemic responses that result in exacerbated inefficiencies in the use of public funds for healthcare.

Shortages of medicines when they are required: Shortages occur when the supply of medicines at PHIs are insufficient to meet demand at any given point in time. Medicine *shortages* have been recorded in the public healthcare system, both in Union government and state government PHIs.

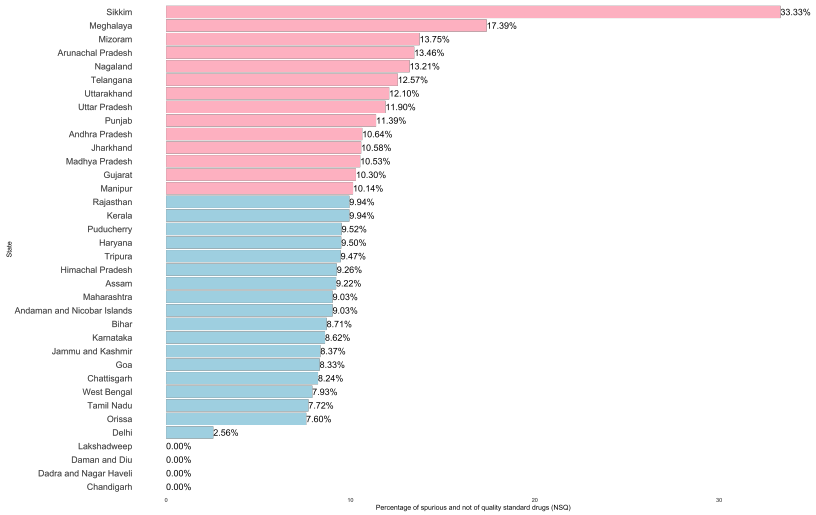
For example, Kotwani *et al.* (2007) find that the median availability of generic medicines was between 0–30% across Primary Healthcare Centers in 5 Indian states (Chennai, Haryana, Karnataka, Maharashtra, West Bengal). Kotwani (2013) found that the mean availability of medicines was 41.3% for facilities run under the State government, 23.2% for those run under the Municipal Corporation, and 49.3% for facilities under the Union government, while studying the availability of essential medicines in 83 Primary Healthcare Centers in Delhi.

Prinja *et al.* (2015) found that nearly 60% of medicines that were unavailable were out of stock for 3-6 months, and 8% were out of stock for more than 6 months across 80 Primary Healthcare Centers across Haryana and Punjab. Sahu *et al.* (2022) and Comptroller and Auditor General (2019) document that 90% of doctors and pharmacists in UP and Uttarakhand, 54% of doctors and 27% pharmacists in Odisha, 50% of doctors in Bihar and 50% of pharmacists from Rajasthan reported incidences of stock-out.

Comptroller and Auditor General (2022) shows that the incidences of shortages are not restricted to Primary Healthcare Centers, but across the supply chain at the government warehouses.

Figure 2 Level of NSQ (Not of Standard Quality drugs) across states in India

The figure presents the average NSQ levels of medicines sampled from private retail outlets across different states in India.



Source: National Institute of Biologicals (2017).

Poor quality of available medicines: There are strict regulations and standards related to the quality of drugs sold in the country. The Drugs and Cosmetics Act, 1940 (DCA) defines 'drugs', lays out quality control standards for drugs in India, as well as the penalties for violation of standards. However, there are multiple instances reported of poor quality medicines.

Singh *et al.* (2020), Thakur and Thikkavarapu (2022) and Kaur *et al.* (2022) report lack of adherence to quality checks within the public healthcare system, despite mandates and regulations. Public Accounts Committee (2013) report that, for medicines procured under the Central Government Health Scheme (CGHS) during the years 2005-06 to 2007-08, out of 1,16,993 tested samples 7,387 samples were declared as NSQ and 256 samples were found to be spurious or adulterated.

The National Institute of Biologicals (2017) reported that the estimated percentage of NSQ drug (Not of Standard Quality drugs) formulations from government sources (10.02%) were higher than from retail outlets (3%). by the Bureau of Pharma Public Sector Undertakings of India (BPPI) in the years 2017-18 to 2018-19, about 0.54%, 0.37% and 0.46% medicines were found to be NSQ. Instances of NSQ drugs are also reported at the State-government level (See Figure 2). Delhi has the least NSQ levels and North-East states perform the worst.

Cost inefficiencies as a drag on public funds An intangible, but critical problem of the public healthcare system is the persistent cost escalations and inefficiencies. Poor medicine procurement processes, in particular, have both visible and invisible cost reper-

cussions.

Budgets for medicine procurement to be made available at a PHI is based on a specific 'scheme' which is funded from the public exchequer and which is used to procure a given medicine. Often, the scheme also specifies who can access the subsidised medicine. For example, the Union government has the National Health Mission (NHM) for general public healthcare, the Pradhan Mantri Bhartiya Janaushadhi Pariyojana (PMBJP) for providing affordable medicines, the National Vector Borne Disease Control Program (NVBDCP) for six specific vector-borne diseases, the Central Government Health Scheme (CGHS) for government employees, and the Armed Forces Medical Services (AFMS) for armed forces personnel. State governments often have their own schemes, in addition to the funds provided to them under these Union government schemes, which are additional demands on public resources.

Evidence shows that there are frequent expenditure inefficiencies when government procures medicines. Comptroller and Auditor General (2022) and Comptroller and Auditor General (2013a) record that when there are shortages, PHIs undertake local purchases at higher prices, which are reimbursed by the scheme.

There are less tangible repercussions of poor medicine procurement. Chaudhury *et al.* (2005) discusses how poor inventory management can lead to wastage of medicines and medical equipment that expires before being used. However, the largest repercussion of poor medicine procurement on wasted public funds is the wasted opportunity cost of under-utilisation of hospitals that cannot function without the required medicines (Muralidharan, 2024).[3] Comptroller and Auditor General (2019) reports that shortages of essential medicines and medical equipment at hospitals and other public healthcare institutions lead to the opportunity cost of having built these facilities, but not using them. The magnitudes of these expenditures are significantly higher than what is budgeted for medicines, which implies a large multiplier effect on cost inefficiencies, arising from the failure of medicine procurement.

If we consider that a good procurement process is one that delivers the correct quantity and quality of goods, in time and at the predicted price, the above evidence points that the Indian public healthcare system procures medicines poorly. In building an argument for what are the ways to improve the procurement capability of the Indian state, it is useful to identify one feature to optimise the system for. We argue that the first order problem to solve in medicine procurement is to reduce the incidence of shortage of medicines within the public healthcare system.

[3]Chapter 12 in Muralidharan (2024) presents a discussion on the failures in the Indian healthcare system, and the public healthcare system in particular.

2.1 Medicine shortages as the first order problem of procurement failure

Why focus on shortages? One of the three outcomes of any goods public procurement is to ensure that the correct quantity is available whenever required (the other two being quality and cost efficiency). This is particularly so for medicines within the public healthcare system. A persistent shortage of medicines at PHIs have a direct and indirect consequence on the health of individuals. Shortages lead to ad-hoc, local purchases by individuals, particularly those who are in dire need of the medicines. When such purchases are made outside the purview of government certified suppliers through the procurement process, these are being purchased at the higher, non-subsidised price, and there is a higher likelihood that the medicines may be of questionable quality. More critically, a consequence of medicine shortages is how it affects the functioning of public clinics and hospitals. As medicines are an essential component of any treatment, preventive or curative, these facilities cannot operate without predictable and guaranteed supply of medicines. By solving for shortages in medicines, it is possible to solve for the failure of services delivery within the public healthcare system.

The objective of reducing shortages narrows the focus of study of public procurement, to understand what are the bottlenecks in the process that prevent the required quantity of medicines being delivered at the required time. Our hypothesis is that this will also help reduce the problems of quality and cost inefficiencies within the public healthcare system.

2.2 Medicine procurement vs. other goods procurement

There is evidence that public organisations that undertake procurement on a regular basis develop capability through the process of 'learning by doing' (Chitgupi and Thomas, 2023). Indian para-statal agencies have been doing goods procurement for decades. Since, medicine procurement is a form of goods procurement, which tends to be less complex than 'services' or 'works' procurement, this would suggest that medicine procurement ought to be done relatively well by the Indian state. However, procurement of medicines has characteristics that differentiate it from other types of goods procurement (Arrow, 1963).

The demand for medicines has a significant unpredictable element each year, with the outset of epidemics and similar unanticipated emergencies. While there is a regular quantity demanded, which can be estimated using information tracking systems of stocks and flows of medicine within the public healthcare system, there is an irregular demand during health-related emergencies, which presents different dynamics in the quantity required. This requires a different capability of not only estimation and prediction, but also agility in supply management.

There is high information asymmetry about the quality of medicines. Unlike goods where

it is easy for the customer to establish whether the quality supplied is the quality demanded, it is difficult to readily establish quality of medicines, particularly for general, or over-the-counter, medicines. Quality checks can be only conducted on samples. Even if these are done when they are delivered, the quality of the medicines at sale will depend upon storage quality and conditions. If all these conditions are not guaranteed, then a certain fraction will likely be ineffective for all quantities delivered. Such failure will drive up the demand for the medicine, causing higher chances of shortages.

Public welfare policies incorporate 'universal access' to medicines by imposing licensing requirements and price caps on all medicine vendors. This, in turn, constraints market forces from responding rapidly to surge demand, and lead to medicine shortages.

Each of these above aspects introduce new uncertainties and challenges into the public goods procurement processes. The management of these risks procurement processes to adjust in order to ensure that medicines supply of the correct quality, and the correct quantities, are available at *all* PHIs, whenever they are required.

In the next section, we undertake one diagnostic approach to address these issues for medicine procurement, which is to study the entire life-cycle of the procurement *contract*. A procurement contract involves following four process stages – full specification of the procurement requirement, tendering and awarding the contract for procurement, contract management and closure. Unlike private sector medicine procurement, the processes for procurement in the public sector are bound by different rules and designated public institutions and agencies. We examine these first in general, and next with more detail in two case-studies, which are widely acknowledged as successful medicine procurement in India: (i) procurement of general medicines by the Tamil Nadu Medical Services Corporation (TNMSC), as an example of procurement by a state level public health care system, for all types of healthcare institutions in the state, and (ii) procurement of medicines under the anti-Tuberculosis (TB) Scheme, as a procurement activity of the Union government for a more narrow set of medicines but deployed at the national scale. In both cases, we focus on the processes of contracting to study what makes for successful procurement.

3 The contract life-cycle of procuring medicines

Public procurement is often treated anonymously with *tendering* for medicines. Tendering starts from publishing a tender which has detailed specification of what medicines are to be purchased with details of time and place of delivery. It ends with the award of contract to an eligible vendor at the lowest ('L1') price. The risks that can delay or stall tendering are seen to either be the lack of competition (one or fewer bids to a tender) or corruption (the tender is narrowly designed to have only one possible vendor).

In contrast, the contract life-cycle approach recognises that procurement is the full pipeline of the contracting process. The use of such a framework lays out all activities and func-

tions required to ensure that the procurement has been conducted successfully. For example, Mehta and Thomas (2022) used the life-cycle approach to study national highways procurement, and found that most disputes arise after the award, and in the contract management stage. This suggests that making improvements to procurement performance requires better capabilities in contract management, rather than only improving the capabilities in the tendering process.

There are four stages of a contract life-cycle when procuring medicines.

Stage I: Determine the procurement requirement. The requirement includes the specification of medicines are to be procured, what is the required quantity of each, specifying the required quality, and the delivery locations and time. The estimation must ideally take into account market conditions, treatment guidelines, seasonality and demographics.[4] These estimates also specify the calendar of delivery required to the PHIs.

Shortages are caused by a lack of accurate assessment of what the demand for a given medicine is likely to be within the public healthcare system. An inaccuracy in demand will lead to a gap in the budgets set aside for medicine procurement, which further exacerbates the potential for medicine shortages.

Stage II: Once the requirement and the budgets have been fixed, tenders are published to invite private parties ('vendors') to bid to supply medicines for the public healthcare system. The processes used in this stage of contracting are defined by the government, in the 'General Financial Rules' (GFR).

Public procurement of medicines is typically done using *rate contracts*. These are awarded to eligible suppliers, using a tendering process that is defined by the government, where vendors that bid the lowest prices are awarded the contract to supply. Often, the tender requires the bidder to quote a price, but without stipulating the quantity that would be required. This has consequences for contract performance. For example, all tendering benefits from a wide pool of diverse vendors, who are willing to provide competitive bids, at all times. A wide pool of vendors allows the procuring agency to maintain a reserve of suppliers during emergencies and to counter supply-chain shocks. However, eligible vendors in India vary widely in their size, which affects their ability to absorb uncertainties in quantity. Ambiguities in the public procurement process will act as a barrier to participation from the wider pool of medical suppliers, and lead to less competitive bids in procurement. On the other hand, accurate specification of requirements give certainty to vendors who are then able to better bid in public healthcare medicine tenders.

Another element of providing certainty is in predictability of the tendering process. Public procurement agencies often delay awarding contracts, which has multiple adverse ramifications on tendering outcomes. Delays in awards lead to high cost of bidding for medicine suppliers. This generates a higher cost for vendors doing future business of

[4]Experts recommend that the National List of Essential Medicines must be revised every 2-3 years. In India, the first list was published in 1996, and the current 2022 list is only the 4^{th} revision.

supplying to the public healthcare system. Further, delays in contract award will result in delays in supply into the public healthcare system. This translates into delays in medicine delivery to the PHIs, who fail to supply medicines to customers.

In order to ensure timely supply of medicines, the government tendering processes should focus on features that incentivise healthy competitive participation of a large variety of eligible vendors to bid for a tender. Two such features are to ensure clarity on requirements and predictability of the tendering process itself.

Stage III: Once the contracts are awarded, the public procurement entity has to manage the awarded contracts, called the contract management stage. There are multiple functions to be undertaken at this stage: (1) Monitor and manage contract performance of the contracted vendors to ensure delivery of the correct quantity *and* quality of the medicine supply, and manage and resolve disputes with vendors, including litigation; (2) Monitor the stock and flow of medicines within all parts of the public healthcare system; (3) Service fresh requests from PHIs for medicines that are out-of-stock.

These can be considered a combination of two functions: (1) the supply chain management of medicines within the public healthcare system, which starts with the procuring agency placing regular purchase orders at pre-determined dates to awarded vendors, all the way up to ensuring delivery from designated warehouses to PHIs during the term of the multiple contracts that are awarded; (2) managing and maintaining a competitive pool of eligible vendors.

A critical component for supply chain management performance is the ability to accurately track information about both the stock and the flow of medicines within the procurement system, including to and at the customer facing PHIs. When medicines are delivered, there are requirements for their batch-wise testing. If the medicines do not satisfy the quality required, action has to be taken both against the non-performing vendor, as well as to re-contract for the quantity that they were responsible for delivering into the public healthcare system contract.

Once the delivery satisfies the quality requirements, the supplied medicines move through the supply chain to PHIs, as specified through monthly or quarterly 'indents'.[5] The lack of mechanisms to trace the stock and flow information of medicines delays both servicing indents and placing indents, both of which result in delayed medicine supply to the customer. Even in the best of systems, a certain amount of local purchases to meet contingencies is inevitable. However, without robust information management within the public healthcare system to account for the presence and location of existing stock, enabling local purchases can cause over-stocking, wastage and overspend of budgets. Most public procurement agencies monitor flows of medicines up to PHIs. Traceability on last-mile delivery to the customers are often deficient or missing. This gap in information about end-customer access is an additional barrier to reducing shortages to the

[5]Indents are formal requests made by PHIs to the procuring agency. It typically outlines the quantity and type of medicines that are required.

customer.

A focus on monitoring information about the quantity and quality of medicines supplied into the system, and information about stocks and flows of these medicines from entry to delivery to the end customer at this stage can help minimise shortages in public healthcare.

Stage IV: Once the awarded contract comes to maturity, there needs to be a verification of contract performance on the part of the vendor to have satisfied the agreed terms of contract and delivery schedule, including quantity and quality checks. On its part, the procurement agency has to ensure timely discharge of all payment obligations, including release of guarantee and security deposit, with a formal statement of contract closure, which may include a mutual release of obligations, signifying that no further claims or actions will be made by either party. In reality, once a contract closes, procuring agencies will renew the contract with vendors.

In this stage, timely payment to vendors builds strong vendor relationships and increases the incentives of vendors to continue engaging with the public healthcare system. Delays in payment leads to vendors having a lack of trust in the procuring agency. This can lead to a disproportional effect: such behaviour and high intangible costs tend to disincentivise the better functioning and cost-efficiency conscious vendors to bid in tenders from the public procuring agency. This leads to a small / non-competitive pool of vendors that the procuring agency can rely upon in future procurement, in normal times or during emergencies.

Contract closure involves timely payments to incentivise procurement participation with a wide pool of vendors, particularly those that are the better performers in ensuring a timely supply of medicines to the public healthcare system.

The contract life-cycle diagnosis of medicine procurement highlights where in the contracting process, a failure in contract performance can lead to shortages in medicine supply. For example, an accurate assessment of the list and quantity of medicines to be procured (Stage I) is crucial for competitive bids during tendering (Stage II), and the management of stock and flows after the contract is awarded (Stage III). Certainty of contract terms in Stage II encourages more accurate supply from the contracted vendors (Stage III). A reliable inventory and supply chain management (at Stage III) brings certainty to such flow of medicines to the PHIs. Therefore, procurement performance on ensuring timely medicine supply to the customers needs state capability at all stages of the procurement process.

We use this approach to study medicine procurement for the Indian public healthcare system. As the first step in the diagnosis, we identify the various entities that form the public healthcare systems in India.

4 Public procurement of medicines in India

4.1 The legal framework

An overview of the legal framework for medicines procurement is presented in Table 1. These form the basis of how procuring agencies and their staff have to procure medicines. Government departments and entities that are involved in the public healthcare system additionally add rules, regulations, guidelines and manuals that establish their own internal processes for medicine procurement.

Table 1 Overview of legal framework for procurement in India

The laws and guidelines for procurement of medicines can be categorised into general procurement frameworks and frameworks specific to procurement of medicines. In each category, the table differentiates between those parts that are enacted by the Union and those by some of the state governments.

General framework	
Instrument	**Description**
General Financial Rules (GFR), 2017	Executive instruments that set general principles of financial management for all Union government bodies, including public procurement.
Manual for Procurement of Goods, 2022	In addition to the GFR, there is a separate manual on detailed procedure for procurement of goods applicable to all Union government bodies. They are non-binding in nature.
Vigilance Manual, 2021	Guidelines by the Central Vigilance Commission for good governance. Includes protocols to ensure cost-effective, competitive and fair use of public funds.
Tamil Nadu Transparency in Tenders Act, 1998	Sets out rules for undertaking public procurement in the state of Tamil Nadu.
Karnataka Transparency in Public Procurement Act, 1999	Sets out rules for undertaking public procurement in the state of Karnataka.
Odisha General Financial Rules, 2023	Lays out general principles of financial management, which include provisions on public procurement.
Sector-specific framework	
Instrument	**Description**
Maharashtra Medical Goods Procurement Authority Act, 2023	Establishes a dedicated statutory authority in-charge of procurement of drugs for the state of Maharashtra.
TNMSC Drug Procurement Policy	Lays out guidelines for procurement and distribution of drugs and medicines, surgical and suture items by the Tamil Nadu Medical Services Corporation to the PHIs in the state.
Indian Railways Drug Procurement Policy, 2015	Lays out the process of procurement for medicines and medical consumables for the health units under the Indian Railways.
Drugs and Cosmetics Act, 1940 read with Rules, 1945	Defines 'drugs', lays out quality control standards for drugs in India, and penalties for violation of standards.

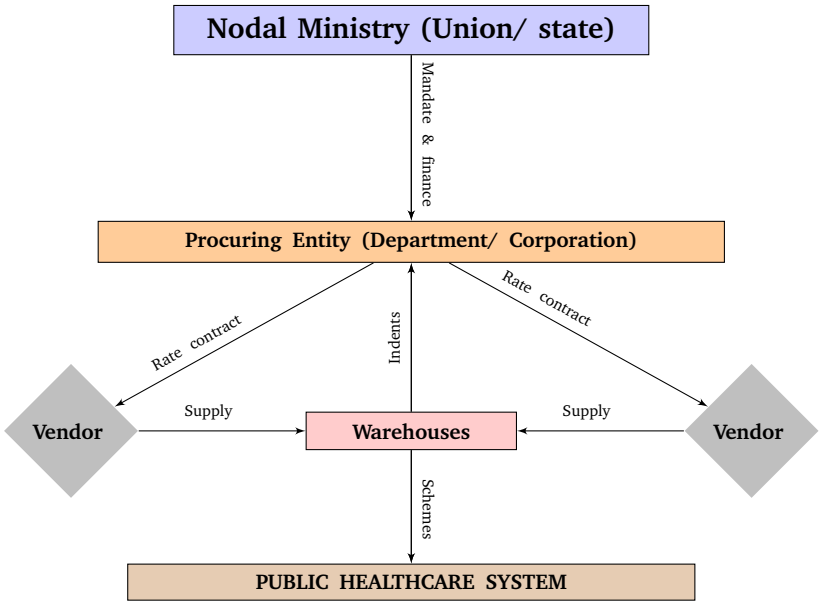
Source: Authors' compilation from the laws and rules governing public procurement in India.

4.2 The institutions

The next aspect of understanding the Indian public procurement of medicines is to identify the entities and agencies which are involved in this activity. Figure 3 presents the institutional network for public procurement of medicines. Each node presents the entities. The grey boxes present the private vendors who are awarded contracts to supply medicines. All the other entities in this diagram are public sector entities.

Figure 3 Institutional structure for medicines procurement

The network of agencies that carry out medicines procurement and their relationship with each other, is presented in the figure below. The key role of each identified agency is to ensure timely supply of medicines to the various Public Healthcare Institutions (PHIs) that form the Public Healthcare System.



Source: Compiled by the authors from procurement manuals on the website of Central Medical Services Society, Medical Services Organisation, Tamil Nadu Medical Services Corporation and other State Government health departments.

We next list the institutional capabilities required to carry out medicine procurement, linking these to the stages of contracting in the previous section.

Stage I: At the Union government, the nodal ministry for procuring medicines is the Ministry of Health & Family Welfare (MOHFW). Within the Ministry, there are several divisions dedicated to specific diseases. For example, the procurement for anti-tuberculosis is headed by the Central TB Division (CTD), and the procurement for HIV/ AIDS is headed by the National AIDS Control Organisation (NACO). Procurement for specific groups of population may be carried out by other ministries, such as the medicine procurement by the Ministry of Railways and Defense. The MOHFW undertakes procurement through the Central Medical Services Society (CMSS).

At the level of the State Government, the respective health departments carry out the procuring activity directly by themselves or through a dedicated medical service corpo-

ration.[6] For instance, states like Tamil Nadu, Kerala and Karnataka have a dedication corporation for procuring medicines. Whereas, procurement in Delhi, Uttarakhand and Himachal Pradesh is carried out by the health and family welfare department of the states. In each case, the relevant procuring agency decides on the design, model and financing for the procurement.

The procurement model can vary along with the institutional design of the agencies themselves (Singh *et al.*, 2013). In India, most states follow a *pooled procurement model*. However, there may be differences within the model. For instance, in Bihar, the volumes of medicines required are pooled at the state level and rate contracted, while actual invoicing and payments are done at district level. In Tamil Nadu, medicine quantities are pooled at state level but payments are also processed at state level.

At the level of Union Government, the MOHFW has budgets for medicine procurement. State budgets for medicine procurement may be supplemented by the NHM funds and other international funds. Several healthcare schemes in India are funded by donor agencies such as the World Health Organisation (WHO), the Global Fund and the World Bank.[7] This may have a material impact on parts of the procurement process, including additional approvals and protocols to be followed during bidding, award, and payments.

Most states in India have a dedicated agency that has charge of medicine procurement. These agencies estimate and specify the medicines procurement requirement. Based on their institutional structure and mandate, approvals or consultations with the health ministry or department may be required. The medicine procurement list is prepared through a *technical assessment* of drug performance. This involves inputs from medical officers, physicians and other experts in the pharmaceutical domain, who are brought into technical or advisory committees, and are consulted prior to finalising the medicine procurement list.

The required quantities of the medicine procurement list are estimated through a *demand assessment*. Ideally, the estimation should include: what is the quantity required under 'normal' circumstances, and what is the additional amount that could be required under an 'emergency' or an 'epidemic'? The assessment of demand under normal circumstances requires information of what was procured in the past under both types of circumstances. In addition, the agency should estimate scenarios which are deviations from the normal, and the quantities that may be required under these. For such scenarios, the procuring agency should identify and block budgets for procuring medicines in both situations.

Stage II: With the finalised medicine procurement requirements, procuring agencies start the process of tendering. This requires identifying eligible suppliers, translating the re-

[6] See Appendix B

[7] The CTD and NACO receive funds from the Global Fund for procuring anti-TB medicines and HIV/ AIDS medicines respectively.

quirements into legal tender documents, which incorporate purchase conditions, as well as safeguards against the risks of contract failure. For this, the procuring agency needs expertise to draft accurate tender documents, evaluate the potential space of bidders, hold pre-bid meetings with qualified vendors to obtain competitive bids, evaluate and award bids. The procuring agency must also be able to renew contracts, under failure of awarded contracts, or if additional quantities are required, either through renegotiation of existing contracts, or tendering for new contracts.

Stage III: After awarding contracts, the procuring agency has to track the flow and stock of medicines. Based on this, the agency periodically places purchase orders. For this, the agency needs updated and integrated information about the stock of medicines, both at the warehouses as well as at the PHIs. Capabilities are required at the level of warehouses and PHIs to use these systems, so as to record timely and accurate information.

Warehouses also perform the critical function of drug quality checks when they take delivery of the supply. Warehouse staff have the responsibility of sending samples to government labs for quality testing. Medicines are delivered to the PHIs only if the sample qualifies the test.[8] Finally, the warehouses and PHIs must also ensure conducive storage conditions for the stock-in hand, and during transportation of the medicines.

Stage IV: In the procurement process, closure of contracts require that payments are made to vendors. These are either made directly by the ministry, or by the procuring agency, depending on the mandate of the procuring agency.

Payments for medicine contracts often have two parts: (i) advance payments (upon contract award), and (ii) payment after the order has been fulfilled. If the supply of medicines is in line with the delivery schedule, timely payments are not a challenge. However, discrepancies may arise if there are defaults by the supplier, or additional demand by the procuring agency (such as during epidemics). The procuring agency needs the capability to manage trust-based relationships with a broad base of vendors through fair contract practices and amicable dispute resolution processes.

This shows that different government agencies can have charge of functions at different stages of the contract life-cycle. The capabilities at each of these agencies will influence the timeliness of the supply of medicines within the healthcare system. We next examine how these functions manifest in the two selected procurement, and what are the capabilities within the Tamil Nadu Medical Services Corporation (TNMSC) and anti-tuberculosis medicine public procurement system that may enable timely supply of medicines within these two systems.

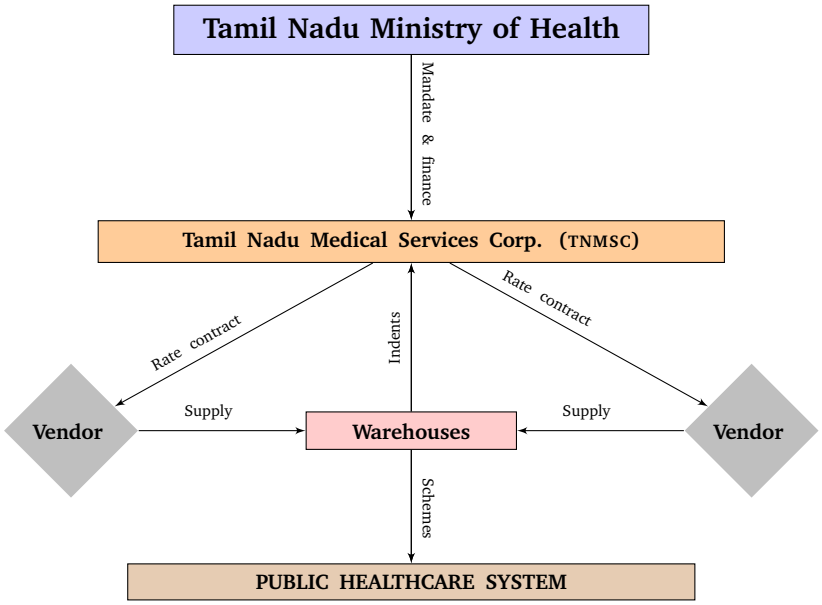
[8] At these PHIs, state drug regulators carry out quality tests. However, the regulatory body is independent and sits outside the ambit of the procurement agency.

4.3 Case study I: Tamil Nadu Medical Services Corporation (TNMSC)

Drugs procurement for the public healthcare system in Tamil Nadu is managed by the Tamil Nadu Medical Services Corporation (TNMSC) and includes a network of 32 warehouses. Together, these agencies manage an inventory of medicines that get delivered forward to the PHIs all through the state. The Tamil Nadu public healthcare system replicates the institutional structure presented in Figure 3, with the TNMSC being the sole procuring entity, and the Ministry of Health being the nodal ministry at the state government as presented in Figure 4. The TNMSC is a 100% government (Government of Tamil Nadu) owned company (Chokshi *et al.*, 2015). It is among the oldest dedicated corporations set up with the sole mandate of procuring drugs at the state-level.

Figure 4 Institutional structure for general medicine procurement in Tamil Nadu

The network of agencies that carry out medicines procurement and their relationship with each other, is presented in the figure below. The key role of each identified agency is to ensure timely supply of medicines to the various Public Healthcare Institutions (PHIs) that form the Public Healthcare System.



Source: Compiled by the authors from procurement manuals available in the website of Tamil Nadu Medical Services Corporation.

Tamil Nadu has historically maintained a strong focus on public healthcare systems.[9] It was the only state to retain its public health department post independence. As a consequence, TNMSC benefited from the presence of a dedicated cadre of medical officers with the skills and capabilities to undertake varied kinds of healthcare functions, including procurement (Somanathan *et al.*, 2009; Parthasarathi and Sinha, 2016). In the 1990s, there was a problem of acute shortages and poor healthcare delivery outcomes

[9]There was strong financial support for reforms in this sector. Financial grants from the Danish International Development Assistance and the World Bank in the 1990s helped to reform both the public health care, and the primary healthcare facilities. See Danish International Development Agency (1999).

in the state, which led to an investigation into the corruption, irregularities and systemic failures that was at the root of the problem (Mishra, 2014). This was the genesis of TNMSC.

TNMSC is funded to procure drugs from multiple sources including the Department of Health and Family Welfare of the Tamil Nadu state government, the National Health Mission, and other international organisations. TNMSC is allocated 90% of the total budgetary funds dedicated to drugs procurement, and is in-charge of procuring drugs for every PHI in the state. The remaining 10% is set aside by the Department of Health and Family Welfare for local purchasing directly by the PHIs, to meet contingencies. The procurement volumes of TNMSC have multiplied three times (from Rs. 357 crores in 2013-14 to Rs. 965 crores in 2021-22).[10]

TNMSC procurement is guided by the Tamil Nadu Transparency in Tenders Act, 1998 read with the respective Rules, 2000 (TN Act), over and above the GFR that guide procurement nationally. TNMSC also relies on the Drug Procurement and Quality Control manual,[11] which details protocols, procedures and guidelines specifically for drugs procurement.

Procurement protocols followed by TNMSC

TNMSC has been widely recognised and emulated for best practices in drugs procurement across the country (Department for International Development, 2008). Drug procurement practices in place at TNMSC, such as centralised tendering, pooled purchasing, and decentralised warehousing, have been recommended across the country to enhance accessibility of drugs (Lalitha, 2005; Singh *et al.*, 2013, 2012; Parthasarathi and Sinha, 2016; Narayanan, 2010).[12] The following analysis focuses on processes and capabilities at each stage of the contract life-cycle that have the potential to address the problem of shortages.[13]

In Stage I, TNMSC estimates and plans for medicine requirement. This is done based on procurement manuals and rules which TNMSC has institutionalised for medicine procurement in their Drug Procurement and Quality Control manuals. A detailed comparison of the TNMSC procurement rules with the GFR is documented in Appendix C.

As the nodal procuring agency within the state, TNMSC estimates the annual procurement requirement of medicines based on its own estimation as well as the past indents raised by PHIs.[14] The medicines that TNMSC procures can be divided into 3 lists: the Essential

[10]Performance Budget of Health and Family Welfare Department, Government of Tamil Nadu (FY18 - FY22)

[11]Drug Procurement and Quality Management Manual, TNMSC, as updated in 2023.

[12]Our study of the TNMSC practices is based on both a study of the Drug Procurement and Quality Management Manual of TNMSC, and conversation with TNMSC staff.

[13]Details are listed in Appendix C.

[14]This is approved by the "Drug Committee of TNMSC". This comprises of: (i) Director of Medical

Drugs List (EDL), Specialty Drugs List (SDL), and Tracer Essential Drugs (TDL) List.[15] Each list is procured for different PHIs. SDL items are procured for tertiary healthcare centers, and EDL items are procured for primary healthcare centers.

TNMSC provides clarity on required quantities: contracts prescribe a min-max range for quantities, which is typically at the range of 25%.

TNMSC deploys data-based demand assessment methodology. Consumption data is gathered by TNMSC warehouses on stock and flow of medicines, and made available for demand assessments in the following year. This helps estimation for EDL requirements, with records of past consumption patterns, local needs, district-wise demographics, seasonality and frequency of outbreaks. It also allows for identification of slow moving, non-moving, and out-dated items, and special requests which are made by PHIs for SDLs.

There is a regular revision of procurement lists. Division of drugs into EDL, SDL and TDL ensures updated lists of medicines and targeted procurement systems. Each is annually updated in consultation with experts and physicians.

In Stage II, TNMSC maintains a wide base of eligible vendors who are empanelled to supply medicines when required. TNMSC eligibility criteria is in line with the WHO recommended best practices, where bidders have the opportunity to match the **L1** price (World Health Organisation, United Nations Development Programme, United Nations Population Fund, World Bank & United Nations Children's Fund (UNICEF), 2007). The average time taken to finalise and award a contract at TNMSC is 120 days to accommodate the mandatory inspection of the vendors manufacturing facilities.

In Stage III, TNMSC places purchase orders with contracted vendors once or twice a month, based on the type of medicines required.

Information flows are managed by TNMSC through a system called the 'Drug Distribution Management System' (DDMS) on changes in demand estimation and available inventory. This system contains records about stock status, previous purchases, demand requirements of PHIs, and local purchase records. PHIs place indents with the TNMSC warehouses through the DDMS. The TNMSC Assistant Manager (purchase) and Manager (purchase) verify the indents, before placing orders with the suppliers.

The monitoring cycle starts when PHIs place indents and ends when the TNMSC delivers the medicines to the PHIs. For any additional requirements of medicines mid-year, requests are placed solely through the portal and processed by designated officials. If there is a shortfall, PHIs are notified about fresh stocks through DDMS.

Education, (ii) Director of Medical and Rural Health Services, (iii) Director of Drugs Control (regulator), (iv) Director of Medical and Rural Health Services (ESI), (v) Director of Public Health and Preventive Medicine, (vi) Director of Family Welfare, (vii) Chief Physician, and (viii) Specialists and Surgeons. See Drug Procurement Policy, TNMSC.

[15] EDL constitutes about 350 drugs, TDL constitutes 43 drugs, and SDL comprises 500 drugs. These figures are as of 2023. EDL comprises of routine, time tested drugs. Whereas, new formulations or experimental drugs or specific disease related drugs find its way into the SDL.

DDMS has information to minimise wastage by expiration. TNMSC uses this information to track inventory that is nearing expiration, and optimally move of such medicines to warehouses where demand is expected to be high.

The information system has a gap in visibility over last-mile delivery. There is a lack of oversight and control, beyond the warehouses, and so there is no systematic tracking of the last-mile movement of medicines to the PHIs.

In Stage IV, TNMSC directly makes payments to the vendors within 15 days after the medicines are delivered to the warehouses. Since it is the designated nodal procuring agency controlling 90% of total medicine procurement budget, there is lower scope for financial constraints. TNMSC is also allowed to charge a 5% operational fee on all transactions through which it finances its operations.

4.4 Case study II: the anti-tuberculosis (anti-TB) Scheme

Timely supply of medicines is a critical part of treating adults for tuberculosis (TB).[16] India has had an anti-TB program since 1962 after the WHO declared a global emergency. The program is run under the National Strategic Plan for Tuberculosis Elimination (referred to as 'the Scheme' in the following). The Scheme was revised in 1993 to run across different phases, and is currently running the 4^{th} phase. It originally targeted to maintain supply of anti-TB medicines at the PHIs, but is now targeting to supply to select private clinics and pharmacies as well.

There are two ways in which the task of procuring medicines to treat TB differs: (1) The treatment involves administering fixed dose combinations, repeatedly for about 4-9 months. Therefore, medicine shortages breaks the continuity of treatment, and impairs the effectiveness of the medicine.[17] (2) This is a national scheme, run by the Ministry of Health and Family Welfare of the Union government. Procurement for anti-TB medicines for the healthcare system is done by the Union Government, and then delivered across the country, into various state level public healthcare institutions and entities. This is a different task in terms of scale and complexity, which involves intricate coordination across multiple levels of the state, and can be effective only with the requisite state capability to implement (Krishnan, 2020).

As a reflection of the broader scope and reach required, the institutional structure of the anti-TB medicines procurement has several more layers of inter-mediation in order to ensure supply of the anti-TB medicines, consistently, to the last mile PHIs. The additional layers of agencies is presented as part of Figure 5. The procuring entity that has charge of setting the list of medicines, the requirement estimation for annual procurement, the allocation of the funds that are budgeted is the Central TB Division (CTD) which functions

[16]Children are administered the preventive treatment for TB through the BCG vaccine, which protects for up to 15 years.

[17]This includes other adverse consequences including drug resistance and relapse of the disease.

under the MOHFW. A separate entity which is autonomous body under the MOHFW called the Central Medical Services Society (CMSS undertakes the function of issuing tenders, awarding and executing rate contracts. The CTD has the final accountability for the performance of the anti-TB Scheme.[18] These two agencies then coordinate with warehouses and drug stores at state, district and TB units at the sub-district levels to provide anti-TB medicines into the state level PHIs.

Procurement protocols followed under the anti-TB Scheme

The multiple institutions in Figure 5 base their procurement planning on the following protocol documents under the Scheme: Technical Specification of Anti-TB Drugs, Standard Operating Procedure Manual for Procurement and Supply Chain Management, Training Manual on Procurement, Supply Chain Management and Preventive Maintenance, and the Ni-kshay Aushadhi Manual. In addition to the relevant Scheme documents, our analysis incorporates information from the annual reports of the Scheme, the Standard Operating Procedures and Guidelines published for the personnel implementing the Scheme, tender notices and draft contract published as tender documents.[19]

At Stage I, the CTD estimates the annual procurement requirement of medicines based on the protocols, guidelines and manuals listed above. These are different from the standard procurement requirements listed in the GFR, the details of which are listed in Appendix D.

There are two ways in which the CTD estimation of anti-TB scheme medicine requirement differs from the TNMSC: the procurement of anti-TB is a national scheme. CTD has to incorporate requirements at all institutional elements in Figure 5, from warehouses to the different state data collection cells to the PHIs in the state. Another difference is that, unlike with public procurement for generics, variability in demand presents a challenge to accurate estimation of anti-TB medicine requirement. The highly communicable nature of tuberculosis can lead to significant fluctuations in medicine requirements. While protocols exist for placing additional orders and transferring stocks between warehouses, these processes can be time-consuming and expensive, potentially leading to shortages.[20]

CTD assesses the demand for anti-TB medicines in the country based on (i) stock in hand (opening/ issued/ received/ closing); (ii) stock in procurement pipeline; (iii) past consumption patterns; and (iv) patient enrollment data. The CTD accesses all data related to the stock and flow of medicines through a data collection and management platform

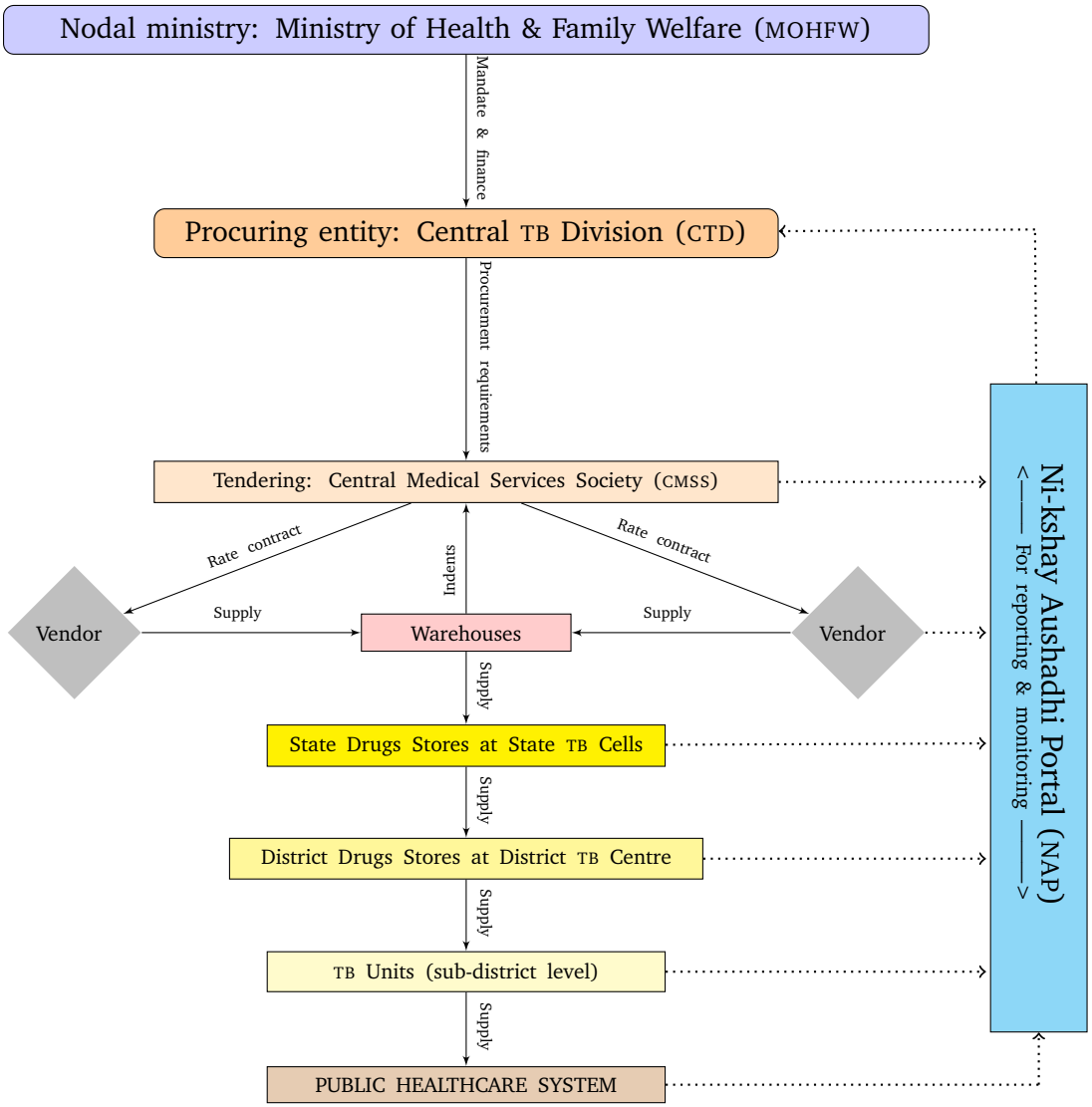
[18]Together, CTD and CMSS under the anti-TB Scheme undertake the functions of the TNMSC for the Tamil Nadu public healthcare services.

[19]The source for this is the website of the Central Tuberculosis Division, National Tuberculosis Elimination Programme, `https://tbcindia.mohfw.gov.in/`, last accessed on July 2022.

[20]Shortages of anti-TB drugs in PHIs in the second and third quarter of FY 2024 have been reported by Debroy (2023); Prasad (2023), with rebuttals from the government.

Figure 5 Institutional structure for anti-TB medicines procurement across India

The procurement of anti-TB medicines is managed by two different government agencies. The functions of demand assessment, release order for supply, and payments lie with the Central TB Division (CTD) under the MOHFW. The functions of issuing tenders, awarding and executing rate contracts are undertaken by CMSS, an autonomous body under the MOHFW. For the purpose of anti-TB medicines, CMSS acts per the directions of CTD.
Once the medicines are supplied to the warehouses by the suppliers, there are 3 downward units - at the state level, district level, and sub-district level - that manage the stock and supply of anti-TB medicines. Flow of medicines from one unit to another is based on instructions from the CTD.
One of the key roles of each identified entity is to ensure timely supply of anti-TB medicines to customers at the various Public Healthcare Institutions (PHIs) that form the Public Healthcare System.



Source: Compiled by the authors from the anti-TB Scheme documents available on the website of the Central Tuberculosis Division.

called the 'Ni-kshay Aushadhi Portal' (NAP). All participants in the institutional design of the public healthcare system for anti-TB connects with the NAP to both (a) submit information and (b) access the information.

CTD revises procurement lists for the anti-TB medicines in-line with the WHO treatment guidelines. These include technical specifications such as formulation and composition of the medicine, and going up to shelf life, storage, packaging and quality parameters. This helps the demand assessment to be in line with contemporary global market conditions, innovation and treatment standards.

Finally, the CTD uses two approaches to manage anti-TB medicine shortages that arise. They allow state governments to make local purchases for up to 25% of the required quantity annually. However, state procurement agencies often lack the capability to handle such procurement. Instead, CTD has started the integration of private healthcare entities into the Scheme. Private diagnostic centers are mandated[21] and incentivised[22] to report TB incidences and drugs administration to the CTD. More than half of the TB patients in India seek care from the private sector. 32% of TB case notification is from private sector. Free anti-TB medicines are supplied by the government to many private clinics and pharmacies.[23] While both approaches are being implemented, shortages tend to persist in both the public and private healthcare systems (Shah *et al.*, 2024).

In Stage II, CMSS publishes tenders, invites bids and awards contracts, which are governed by GFR protocols. The rules do not specify any time limits for this process under the Scheme.

In Stage III, while CMSS issues purchase orders, CTD retains a substantial degree of management control for the movement of medicines through the institutions that make up the supply chain management through the states. For example, CTD has to approve the issue of purchase orders to awarded vendors for delivery of medicines to the warehouses. CTD communicates the dispatch of medicines to the State Drug Stores (SDS) at the State TB Cell, through release orders to warehouses. The quantity of medicines that is dispatched is determined by the stocking and reserve guidelines stipulated by the CTD under the Scheme.[24] When the SDS received the medicine, it issues and dispatches medicines to the District Drug Stores (DDS), from where it moves sub-district TB units, and then to PHIs.

CTD manages information flows using the NAP, which collects and manages all information flow of medicines at warehouses, SDS, DDS, sub-district TB units and PHIs. The reporting frequency is in the form of a monthly report by PHIs and quarterly report by the

[21] In 2012]MOHFW mandated TB notification from all health care providers. In 2015 this was amended to mandate all laboratories to notify TB cases. In 2018 all chemists were also mandated to inform about TB patients to whom they have dispensed anti-TB drugs. See `https://tbcindia.gov.in/showfile.php?lid=3136` and `https://egazette.nic.in/WriteReadData/2018/183924.pdf`

[22] Rs. 500 per patient is provided for TB notification and treatment outcome declaration by private sector.

[23] In 2019, about 50,000 patients received free anti-TB medicines from private sector.

[24] The stocking norms are set out in greater detail in Appendix D.

other units, as well as the receipt and dispatch of medicines by all units. NAP information collection is not just from the public sector institutions, but also the private vendors. Supplying vendors upload batch-wise details of the medicines that they dispatch, including expiry date, expected delivery date, and quantity. NAP offers clarity on the stock and flow of medicines within the TB healthcare system at all times, presuming that the reporting is done correctly by each unit and as per schedule.

CTD information monitoring the information in NAP allows for a 'centralised' demand assessment and dispatch to the SDS and DDS. NAP also facilitates 'decentralised' monitoring and management by the State TB Cell and District TB Centre for TUs and PHIs. This allows institutional agencies at different levels of the anti-TB public healthcare system to manage inventory and demand changes, by initiating and allowing transfer requests across districts and states.

NAP has information to minimise wastage by expiration. Updated information on medicine inventory within NAP allows CTD, SDS and DDS to monitor stocks that are close to expiry, and to request transfer requests of the medicines across warehouses. CTD approval is required across states, while the State TB Cell can approve transfer across districts.

NAP has visibility over last-mile delivery. All PHIs are mandated to record the name of the medicine and quantity dispatched along with the patient ID on NAP. CTD can track whether the medicines are reaching the end consumer/ citizen or not.

In Stage IV, CTD clears payments, once warehouse agents update their acknowledgment of receiving quantity supplied on NAP.

5 Improving supply of medicines for Indian public healthcare

The contract life-cycle analysis of the TNMSC and the CTD under the anti-TB scheme offers the following insights of what can enable reliable medicine procurement.

Protocols and guidelines for procurement practise

The analysis highlights the importance of well-defined protocols and guidelines for procurement processes. Both TNMSC and CTD have developed standardised manuals for procurement that cover processes to finalise medicine lists, calculate required quantities, and to handle emergencies.

For example, TNMSC has standardised processes through own protocol manuals and guidelines with different processes for essential, tracer and specialty medicines. These processes vary from the GFR process in all four stages of the procurement contract. The manuals define the processes to finalise the medicine lists, and processes for calculating quantities required using specific sources of information.

Similarly, the anti-TB Scheme has standard operating procedures, manuals and guidelines for each part of the procurement process. This includes processes for inventory management, operation of NAP, and for operation of drug stores. Only for tendering bids and awarding contracts does the CTD follow GFR processes. The NAP system collects and maintains records about annual demand, quarterly and monthly contracts to manage medicine stocks and outflows at a national level. This information is consolidated at the warehouses, the multi-level state drug distribution centers, the PHI units dispensing the anti-TB medicines, as well as at the level of the patient.

The CTD protocols also include training to develop procurement capacity. The State TB Cell, District DB Centre and the sub-district sub-district TB units are staffed with a nodal TB officer, a medical officer, a pharmacist/ storekeeper, and a data entry operator for NAP. The officers are trained at the national level and state level by the National Technical Support Unit and State Technical Support Units set up to build capacity and provide technical training for implementation of the Scheme. Further, a National Technical Expert Group has been set up to advise CTD on TB treatment and policies. This is an important process feature to enable the correct implementation of process manuals.

Digital information management systems

Robust information systems are crucial for managing regular goods procurement activities. In particular, digital systems enable efficient documentation, information capture, and end-to-end tracking of medicine inventory and outflows throughout the healthcare system. In most public procurement of medicines in India, purchase orders are issued to vendors throughout the year, based on indents raised by warehouses. There is evidence suggesting that current indenting practices results in shortages, either due to incorrect estimates of quantity in indents, and/or due to delays in indenting (Comptroller and Auditor General, 2022, 2013b). In both cases studies, information about requirement and inventory is obtained through digital IT systems.

For example, TNMSC obtains stock and flow information at the DDMS, which includes information across all three lists – EDL, SDL, and TDL. DDMS also allows better integration of warehouses into logistics management. When there is a shortfall, TNMSC is able to use the DDMS to fill the gaps with local purchase records at the right time and the right price (Government of Odisha, 2008). Access to this information helps PHIs place indents more accurately.

A gap in the information collected within the DDMS is what is demanded by the end customer. This limitation stems from the mandate of TNMSC, which states " ... *achieving the primary objective of ensuring ready availability of all essential drugs and medicines in the Govt Medical Institutions throughout the State by adopting a streamlined procedure for their procurement, storage and distribution.*" The TNMSC system does not have data within the DDMS about the extent to which indents placed by the PHIs are received at either the PHIs, or the customer. Thus, the precision of stocks and flow information stops at the level of the warehouses and the indents placed by the PHIs. The conditions and uptake

of medicines by the end customers at the PHIs is outside the purview of TNMSC. In part, this is because the management of the PHIs rest with the state government, rather than with TNMSC.

The anti-TB Scheme does not have these problems. The CTD estimates annual demand assessment from the NAP, which has updated stock status and demand information at warehouses-level. Every unit in the anti-TB institutional network presented in Figure 5 is mandated to report supply into and out of the system into NAP. The designated officer at each unit has to physically verify the stock status, which is using his/her own login ID/password credentials. This process is designed to reduce delays and human errors, while also ensuring accountability of designated officers. Since such capacity can vary widely across different states where the anti-TB Scheme is available, there needs to be regular training and support to maintain the performance of anti-TB medicine delivery across all states.

Unlike the DDMS in TNMSC, the NAP provides visibility over last-mile delivery. PHIs are mandated to record the Nikshay ID of the patient on the NAP while issuing anti-TB medicines to patients. Anti-TB medicines can be issued to patients without an ID, only once, post which the patient is enrolled onto NAP.

Medicine procurement processes for crises

State capability is critical in managing procurement during crises. Both TNMSC and CTD have specific provisions and processes throughout the contract life-cycle for procurement during a medical or health emergency, particularly regarding budgeting and financial planning.

Access to funding is essential. TNMSC, for example, reserves 10% of procurement funds to finance local medicine purchases by PHIs during significant supply shortfalls. Additionally, TNMSC contracts with reserve suppliers, who are identified during the regular tendering process, to address emergency requirements. For example, a part of defined procedure at TNMSC during emergencies is a formal practice of inviting all bidders to match the 'L1' tender, after the opening of financial bids. TNMSC builds systems for emergency procurement by having reserve suppliers, who placed a bid during the normal tendering process but did not match $L1$ upon invitation.

The anti-TB Scheme has a "Results" Framework that that incorporates impact and outcome indicators into budgeting. This includes data on "No. of TB cases notified", "No. of TB cases put in treatment" and "Treatment success rates".[25] This framework links funding disbursement to achieving specific outcomes, which enables flexibility in resources for medicine procurement during emergencies.

Building and managing networks of trusted medicine suppliers

[25]The indicators come from the funding model of the Scheme, which is funded from multilateral agencies like the World Bank as well as The Global Fund, and links the disbursement of funds directly to the achievement of specific outcomes defined as 'Disbursement Linked Indicators' (DLIs).

A critical element for timely medicine supply is building trust-based relationships with a broad base of suppliers, who, in turn, can be trusted to perform on their contracted obligations. Contract performance on the part of the procuring entity to build such relationships hinges on accurate requirement specifications (including medicine type, delivery schedules, pricing, quality standards), and predictable responses to non-performance. As in the manner of all transactional relationships, prompt payments to vendors foster trust and encourage participation in future tenders.

TNMSC exemplifies trust-based relationships with suppliers. They maintain prompt payment practices and avoid blanket debarment for supply defaults, recognising that external factors can impact generic medicine manufacturing (Kondserovsky *et al.*, 2022). When imposing penalties for non-performance, TNMSC contracts have penalty provisions that differentiate across non-supply, short-supply and delayed supply, which incentivises vendors to fulfill contract terms to the best of their abilities.

In the case of the anti-TB Scheme, the bidding process by CMSS allows partial bidding, for a portion, rather than the entire quantity. The delivery schedule (quantity and time of supply) is provided to the suppliers upfront in the bidding documents, unlike other medicines procurement undertaken by Union Government agencies such as the Medical Services Organisation[26] or The Pharmaceutical and Medical Devices Bureau of India under the Department of Pharmaceuticals.[27] This allows participation from a wider range of suppliers, including those who have limitations in capacity or resources. This approach fosters better planning for supply constraints and allows suppliers to leverage economies of scale.

In summary, the existing medicine procurement analyses reveal four key elements for reliable public medicine procurement in India: standardised protocols and guidelines, digital information management systems, medicine procurement processes for crises, and building networks of trusted suppliers. These are elements that can be developed and improved by medicine procuring agencies to bolster their own processes and capacity to ensure timely medicine supply within the public healthcare system.

State capability is required to implement these elements. This requires to put in place elements to build and maintain capability: within officers, PHIs, health departments and the procurement agencies themselves. For example, while it is possible to outsource the development of a digital information management system, or a supply chain management function, the state remains accountable to the end users of the public healthcare system. For the timely availability of medicines, this means that the officers and staff procuring agencies must be regularly trained to carry out the functions at all stages of

[26]Bid Document For Rate Contract for Supply of Generic Drugs, Medical Services Organisation, available at `https://dghs.gov.in/WriteReadData/Tender/20180926035750705697 6TENDERDOCUMENT05(1).pdf`, last accessed on October 2024.

[27]E-Tender for Supply of Surgical, Consumables and Medical Devices, The Pharmaceutical and Medical Devices Bureau of India, available at `https://janaushadhi.gov.in/tender/Proc\%20Tender-216_29072024.pdf`, last accessed on October 2024.

the medicine procurement process.

6 Conclusion

The activity of medicine procurement is more than just tendering for medicines. It is the entire contract life-cycle from specifying what is required, to tendering, to contract management. Procurement, therefore, involves institutional processes, capabilities, and rules that formalise what goes into the contracting activity - from designing what needs to be procured to managing the contracts that are awarded, from taking and making delivery of what is contracted, maintaining vendor relationships to ensure that citizens are served through normal times and through periods of emergencies when the usual order of private vendors doing business faces stress. A thorough grasp of the different parts of contracting is instrumental in understanding how to reduce irregularities and gaps that arise in public procurement.

Applying this framework to study the problem of shortage of medicines in the public healthcare systems identifies the need to develop four key elements of the procurement process. First, while medicine procurement is an annual, routine activity undertaken by dedicated agencies, these agencies may be staffed by officials with limited tenure and limited domain knowledge, at a given point in time. Codifying detailed protocols and compliance for each stage of the procurement activity ensures that institutional knowledge is systematically retained and so can be readily imparted. Second, sound information systems that mandates reporting of quantity and condition of medicines by officials at each touch points is critical to allow the procuring agency to monitor the flow of medicines, and enable prompt and accurate procurement decisions. Third, the processes must be in place to manage procurement in both normal times and during crisis episodes. Fourth, certainty about contracts and contract performance incentivises suppliers to work with the government to ensure frictionless and timely supply of medicines. Long-standing relationships with suppliers become crucial in order to reduce shortages within the public healthcare system.

Our findings, similar to Singh *et al.* (2012), questions the blanket application of 'corporation' models to public procurement across sectors and states. We argue that a deeper understanding of organisational capabilities, mandates and functional processes is crucial. In the field of public healthcare, this paper places clarity of procurement mandates and processes to ensure timely and predictable access to medicines for citizens, suggesting that this is a key performance metric for the public healthcare system.

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A The footprint of the public healthcare system

Table 2 Scope and services of PHIs in India

Following is a non-exhaustive list of citizen-facing, last-mile delivery institutions operating under different schemes of the government. Each institution provides distinct healthcare services and serves a specific category of the population.

Institutions	Function
Primary Health Centres (PHCs)	PHCs supply medicines such as antibiotics, analgesics and anti-inflammatory drugs. This is administered by the PHCs staffed with a medical officer and a paramedic staff. Each PHC serve $\approx$ 30,000 citizens.
Sub-centres (SCs)	Each PHC supervises 6 sub-centres. Sub-centres are the most peripheral units. They are the first contact point between the PHC and the community.
Community Health Centres (CHCs)	When primary care is insufficient, patients are referred to CHCs for secondary level of health care. CHCs constitute first referral units, sub-district hospitals and district hospitals. 4 PHCs are included under each CHC. Each of them serve $\approx$ 1,20,000 citizens.
Medical Colleges	Medical colleges often have affiliated hospitals that provide tertiary health care. They supply high-end antimicrobial, and medicines for conditions like resistant tuberculosis, malaria, kala-azar, cancer.
Dispensaries	These are stand-alone units under different healthcare schemes of the government. For instance, Employees' State Insurance (ESI) dispensaries, AYUSH dispensaries, and CGHS dispensaries.
Wellness Centres (WCs)	WCs provide comprehensive medical care to the Central Government employees, both serving and pensioners, their dependent family members and such other categories of CGHS cardholders.

Source: Compiled by the authors from the website of MoHFW, Government of India.

Table 3 Scale of operations of PHIs in India

Accurately determining the quantum of medicines procurement in India presents significant challenges. The table below illustrates the annual growth and expansion trends of PHIs across India. Given that medicines are an essential component of healthcare services at all levels - primary, secondary, and tertiary — the scale of PHI expansion can offer approximate estimates of procurement of medicines.

Year	SCs	PHCs	CHCs	Sub-district Hospitals	District Hospitals	Medical Colleges	WCs	Dispensaries
2018-19	152794	20069	5685	1234	756	240	412	5056
2019-20	157921	30813	5649	1193	810	274	415	6306
2020-21	157819	30579	5951	1224	764	307	419	7557
2021-22	161829	31053	6064	1275	767	315	-	-

Source: Compiled by authors from Annual Reports of MoHFW.

B State-level procuring agencies

Table 4 Institutional design of procuring agencies across states

Some states have a dedicated Medical Services Corporation for procuring medicines, while others procure through their respective health department. We show the institutional design of procuring agencies across 18 states in India.

State	Procuring entity	Year
Andhra Pradesh	AP Medical Services and Infrastructure Corp	1984
Assam	Assam Medical Services Corporation	2016
Bihar	Bihar Medical Services and Infrastructure Corporation	2010
Chattisgarh	Chhattisgarh Medical Services Corporation Limited	2010
Delhi	Department Health and Family Welfare	-
Gujarat	Gujarat Medical Services Corporation	2012
Himachal Pradesh	Health and Family Welfare Dept.	-
Karnataka	Karnataka State Medical Supplies Corporation Limited	2002 (2019)
Kerala	Kerala Medical Services Corporation	2007
Maharashtra	Department of Health and Family Welfare (Law passed to set up a Corporation)	-
Madhya Pradesh	MP Public Health Service Corporation Limited	2014
Odisha	Odisha State Medical Corporation	2013
Punjab	Punjab Health Systems Corporation	1997
Rajasthan	Rajasthan Medical Services Corporation	2011
Tamil Nadu	TN Medical Services Corporation	1994
Uttarakhand	Department of Medical Health and Family Welfare	-
Uttar Pradesh	UP Medical Services Corporation	2018
West Bengal	WB Medical Services Corporation	2008

Source: Compiled by the authors from the website of the respective corporations and health departments.

The broad mandate of all the procuring agencies set out above is: Procurement of medicines, medical equipment, services and sutures, with the objective of improving access to healthcare in India. Some distinctions in the mandates of these agencies include,

- Andhra Pradesh and West Bengal that list hospital building and infrastructure construction as the primary mandate.
- Punjab includes preventive, promotive and curative healthcare within its scope, with a focus on rehabilitation and mental health infrastructure.
- The Delhi Department of Health and Family Welfare also procures for Mohalla Clinics in the city.
- Kerala's mandate includes trauma care and ambulance services.
- Gujarat has a market intelligence wing tasked with updating knowledge on vendors and new medicines through surveys, research and field visits.

C Tamil Nadu Medical Services Corporation (TNMSC) Protocols

Table 5 Stage-wise procurement practices at the TNMSC

This table presents a list of provisions in different stages of contracting for medicines. The first column has the provisions in the 'General Financial Rules' (GFR) of the Union government at the different stages of contracting. The second column are the details of the protocols that are used by the Tamil Nadu Medical Services Corporation (TNMSC) in the same stage of contracting. This comparison serves to portray the differences between the rules and guidelines established by TNMSC, and those in the GFR.

GFR Provisions	**TNMSC Protocols**
Stage I: Establish Requirements and Delivery Schedule	
No provision on demand forecasting, periodic assessment or procurement planning	Protocols to divide drugs into (i) Essential drugs list (EDL), containing 350 drugs as of 2023; (ii) Tracer Essentials, that contains 43 drugs as of 2023; and (iii) Specialty Drugs List (SDL), with 500 drugs as of 2023. These lists are finalised *annually* by a Drug Advisory Committee, comprising of: (i) Director of Medical Education, (ii) Director of Medical Services, (iii) Drugs Control Officer of the State, (iv) Director of TNMSC, (v) Director of Public Health Department and (vi) Director of Family Welfare Department. Finalise quantity requirements based on (i) How much the PHIs picked up from the warehouses; (ii) Internal factors such as past consumption patterns, local needs, and district-wise demographics; (iii) External factors such as seasonality, frequency of outbreaks, and contingency reserves; (iv) Additional quantity of 10%
Stage II: Tendering and Award	
Rule 173 contains procedures to ensure transparency, competition, fairness and elimination of arbitrariness in the procurement process.	Rule 30A-B of the Transparency in Tenders Act, 1998 ('TN Act'), lays out a two-stage bidding process which includes inspection of manufacturing premises followed by price bid. Once L1 is derived, the other suppliers are provided an opportunity to match the bid. On an average, time taken to award contracts is 120 days.
Rule 225 prescribes general principles for contract including, change of scope, price variation, supplier default and extensions to delivery schedule. GFR also prescribes use of rate contracts.	Protocols are mandated in the TN Act to tender rate contracts annually, with quoted prices including basic price, freight, packing & forwarding.

GFR Provisions	TNMSC Protocols
Stage II: Tendering and Award (contd.)	
	Quantity assurances built in by including a min-max range for quantities supplied. Default provisions varying for *non-supply*, *short-supply*, and *delayed supply*: (i) Delayed supply: Penalty of 25% on the unexecuted order amount and cancellation of order if the order is unexecuted beyond 45 days or the extended time granted. (b) Short supply/ non supply: If supply is short by $>$ 70% $+$ short supply of 3 POs of same drug, then blacklisted for supply of that drug for 2 years $+$ forfeiture of performance security. (c) If 50% of the drugs supplied by a supplier is blacklisted, then the firm is blacklisted for 2 years.
Stage III: Managing rate contracts and Maintaining inventory	
Limited provisions on contract management in Rule 226	TNMSC manages its contracts and inventory through an outsourced IT system called DDMS, which generates "Further order quantity" that have to be certified by the Assistant Manager (Purchase) and Manager (Purchase).
According to Rule 209, indents are to be provided for every purchase/transfer internally and receipts are to be issued against each indent serviced.	TNMSC has protocols to track deliveries from the time indents are placed by PHIs up to their supply.
Rules 217 to 219 stipulate that additional goods/ obsolete goods must be disposed of through auctions or scrap sales.	Provisions for when the consumption of any medicine reducing, not required, in an area, medicines are to be transferred to the warehouse, or a letter is to be sent to the PHIs to utilise the medicine.
Rule 214 stipulates maintaining buffer stocks based on consumption data	TNMSC has provisions to enlist suppliers who match 'L1' as reserve suppliers, to provide additional requirement, in case of exigencies. Includes provisions to maintain 4 months of reserve physical stocks across drug distribution warehouses, along with 2 months of stocks in the pipeline for all EDL items.
Rule 312 exempts prepayments by local bodies to central drug purchase authorities in the event of emergency	Provisions to allocate resources to manage local purchases for emergency requirements, including for the inspection of quality and 10% fund retention with PHIs
Stage IV: Taking delivery and Closing payments	
No provisions for tracking supply of medicines to the end-users	No provisions for tracking supply of medicines beyond warehouses outflow.

D Anti-Tuberculosis (Anti-TB) Scheme Protocols

Table 6 Stage-wise procurement practices at the Central TB Division (CTD)

This table presents a list of provisions in different stages of contracting for medicines. The first column has the provisions in the 'General Financial Rules' (GFR) of the Union government, used in the four stages of contracting. The second column are details of protocols that are used by the 'Central TB division' (CTD) in the same stage of contracting under the anti-TB Scheme. This comparison serves to portray the differences between the rules and guidelines established by CTD, over and above those provided for in the GFR.

GFR Provisions	Anti-TB medicine protocols
Stage I: Establish Requirements and Delivery Schedule	
No provision on demand forecasting, periodic assessment or procurement planning	Protocols at the CTD finalise the drug lists annually using information consolidated through the NAP through (a) the periodic usage reports by warehouses, state drug stores, district drug stores, sub-district TB units; (b) Suppliers, who are required by contract, to report supply, as and when they dispatch drugs, and (c) Monthly usage reports from PHIs. Reporting into NAP is mandated for these institutions in all the states in India. Anti-TB medicine usage is directly observed at the individual level, since patients have to be enrolled on to NAP. PHIs distribute medicines only against a patient's NAP ID. Private diagnostic centers receive monetary incentives for enrolling patients.
GFR allows by States / Districts local purchases of up to 25% under the Scheme.	State governments also specify such provisions in state procurement guidelines. According to the Standard Operating Procedure Manual for Procurement and Supply Chain Management, respective state drug stores have to report these as 'Local procurement process' into the NAP. The Union government has issued ad-hoc instructions and permissions to enable States to purchase locally. For example, Maharashtra anti-TB procurement in September 2019 (https://gr.maharashtra.gov.in/Site/Upload/Government\%20Resolutions/English/201908131513233317.pdf) and Tamil Nadu in April 2024 (https://www.thehindu.com/news/cities/chennai/tamil-nadu-turns-to-local-purchases-to-tide-over-tb-drug-stockouts/article68020694.ece)
Stage II: Tendering and Award	
Chapter 6 of the GFR lays out conditions for procurement of Goods.	CTD follows GFR protocols for tendering and award of contracts for procurement of anti-TB medicines.

GFR Provisions	Anti-TB medicine protocols
Stage III: Managing rate contracts and Maintaining inventory	
Limited provisions on contract management in Rule 226	CTD has protocols to manage contracts and inventory through the NAP. NAP provisions require *quarterly* stock reports to CTD from the sub-district TB units, district drug stores, state drug stores and warehouses, who report this information on a periodic basis to the CTD. PHIs have to submit *monthly* stock reports.
Rule 214 stipulates maintaining buffer stocks based on consumption data	NAP protocols require that PHIs submit requisitions for 1 month of stock for utilisation and 3 months of stock for reserve by 7^{th} of *every month* to the sub-district drug stores. Sub-district TB units send requisitions to replenish 2 months' reserve stock by 10^{th} of each *quarter* to the district drug stores. District drug stores units replenish their 3 months' reserve stock with requisitions by 12^{th} of each *quarter* to state drug stores. State drug stores replenish 3 months' reserve stock with requisitions by the 15^{th} of each *quarter* to CTD. Provisions to reduce wastage and stock-outs is based on a review of the stocks at each unit include placing Additional Drug Request' or 'Drug Transfer Advice' by any of the above units on the NAP. Transfers across warehouses or the involved drug store unit requires the approval of the designated officer at the respective State TB Cell and District TB Centre.
Rule 312 of GFR exempts pre-payments by local bodies to central drug purchase authorities in events of emergency	Local purchases by States to manage additional requirements and emergencies is allowed, up to the extent of 25%, under the Scheme, in compliance with the GFR and State Procurement Guidelines.
Stage IV: Taking delivery and Closing payments	
No provisions for tracking supply of medicines to the end-users	Anti-TB medicines are only provided to individuals who enroll through the NAP. In 2015 the MOHFW mandated all diagnostic centres to intimate CTD about patients detected with TB at the stage of diagnosis.