**Good Public Health Logistics: An important element of Resilient Health Systems:**

**Lessons from Tamil Nadu in context of COVID-19 Pandemic**

**- Adithyan G.S and Sundararaman T**

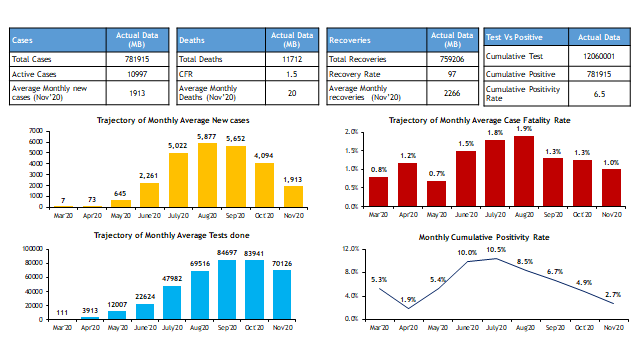
***Abstract:*** *The article highlights the importance of public systems strengthening and how rapid scaling up of access to testing and to appropriate therapeutics in context of COVID-19 pandemic requires robust public procurement systems for drugs and diagnostics to be already in place. The paper deals with the lessons from Tamil Nadu and validates the understanding that investing in public institutions is essential for responsiveness to pandemics and other public health emergencies.*

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On November 1st 2020, Tamil Nadu State has crossed 1 Crore Reverse Transcriptase-Polymerase Chain Reaction (RT-PCR) testing and became the first State to do so in the country (1). The cumulative testing rate for the State currently is about 140,000 RT-PCR tests per million, which is one of the highest testing rates across any larger State in the country. Tamil Nadu’s relative success in containment of the pandemic relates considerably to its testing strategy and the way it geared up public health services in the first few months to ensure much better access to essential technologies for COVID-19 through its network of public health providers. When the lockdown restrictions eased, cases rose in June and July and peaked during mid-August. But from September onwards the rate of transmission curve flattened, and after three months at about 5000 cases per day, cases started declining in mid-November-with currently less than 1500 cases per day. Its mortality rate has remained limited to about 1.5% (0.7-1.9) throughout this period.

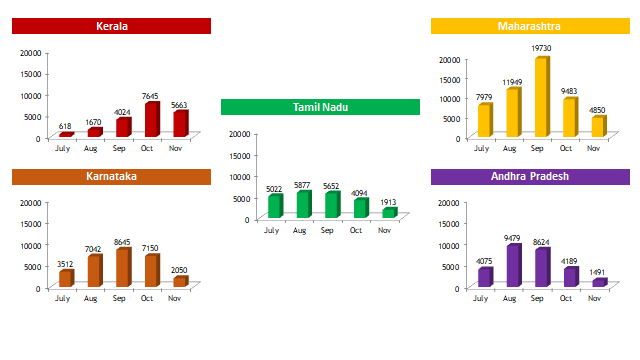
Overall, the monthly data analysis of the key COVID-19 indicators of the State as on 30th Nov, 2020 clearly shows that epidemic is on a declining trend in Tamil Nadu (Fig 1). The comparison between 5 major southern states on the month-end active caseload and average positive cases per day from July 1st, when Rapid Antigen Tests (RATs) were started widely used by States is depicted in Fig 2 and 3 respectively.

**Figure 1: Monthly Covid-19 Details, Tamil Nadu (as on 30.11.2020)**



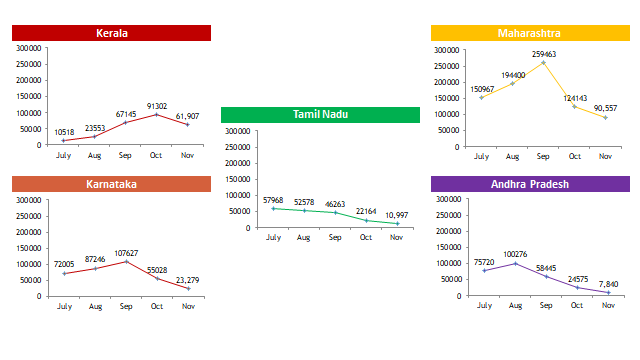
*Source: Media Bulletin, Health and Family Welfare Department (Graphs prepared by authors)*

**Figure 2: Average Positive Cases per day: Comparison of five southern states**

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*Source:* [***www.covid19india.org***](http://www.covid19india.org) *(Graphs prepared by authors)*

**Figure 3: Active Cases-Month wise: Comparison of five southern states**

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*Source:* [***www.covid19india.org***](http://www.covid19india.org) *(Graphs prepared by authors)*

**The choice of testing technology:**

Early in the epidemic, the State Government of Tamil Nadu adopted a policy of using only the RT-PCR, tests- which is considered as the ‘golden standard’. Even when many other States shifted to Rapid Antigen Tests (RATs), Tamil Nadu preferred this option because it had much less false negatives. Rapid antigen tests for COVID-19 are supposedly comparatively cheaper and deliver quicker results than RT PCR but are about 10 times less sensitive than the latter leading to a high number of false negatives (2). Official MoHFW and ICMR guidelines address this by calling for mandatory re-testing with RT-PCRs of all symptomatic patients who test negative with RATs (3). But this is difficult to organize and reports from many states shows that this is not happening, even as per MoHFW (4). Such patients with missed diagnosis, who need to be re-tested, require to be isolated till then, and the failure to do so would be a major source of disease transmission. This also gives a falsely low picture of positive cases, because official figures do not disclose the symptomatic who were not adequately tested. However the advantages of RAT are that that RT PCR machines require more complex logistic support and skilled manpower. The reported cost advantage of RATs during the initial period has since been negated, with the multiplicity of vendor options in RT-PCR and consequent competition driving down the RT-PCR costs while the prices of limited vendor RAT kits has not come down commensurately.

**The development of testing capacity:**

In March 2020, as the pandemic reached the State, it had only one laboratory- with the capacity to test for COVID-19, the Kings Institute of Preventive Medicine & Research, Chennai, which was able to test about 90 samples/day. By April end, with the addition of more testing centres, the testing capacity reached around 4500 tests/day. In the next six months, this capacity rose to 220 testing centres of which 67 were in the government sector and 153 in the private sector - with all districts having at least one dedicated Government lab for RT PCR testing (Table I and Figure 4). The daily capacity of testing is now almost 1 lakh RT-PCR tests per day in government institutions, which is highest among all states. Though the number of government testing laboratories is less than half the number in the private sector, overall 76% of the test load in the State is done by the Govt. RT-PCR laboratories and another 12% covered under Insurance scheme (in private labs) as per Government reports (Figure 5). This became possible because, Government Testing Laboratories were now functioning on a 24x7 basis with additional man power supported by the Government to meet the increased testing capacity that was now required. A total of around 550 laboratory technicians and 250 Lab Attendants were added on in this period.

One major reason why utilization of government testing facilities was higher was because this tests, which costs about Rs 2500 per test in the regulated private sector, was made available free from all government hospitals.

**Table I: District Wise Details of ICMR approved Labs in Tamil Nadu**

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| |  |  |  |  |  | | --- | --- | --- | --- | --- | | **S. No.** | **District** | **Govt** | **Pvt.** | **Total** | | 1 | Ariyalur | 1 | 0 | 1 | | 2 | Chengalpattu | 2 | 13 | 15 | | 3 | Chennai | 13 | 42 | 55 | | 4 | Coimbatore | 2 | 16 | 18 | | 5 | Cuddalore | 2 | 0 | 2 | | 6 | Dharampuri | 2 | 2 | 4 | | 7 | Dindigul | 1 | 2 | 3 | | 8 | Erode | 2 | 2 | 4 | | 9 | Kallakurichi | 1 | 1 | 2 | | 10 | Kancheepuram | 1 | 7 | 8 | | 11 | Kanyakumari | 2 | 2 | 4 | | 12 | Karur | 1 | 0 | 1 | | 13 | Krishnagiri | 2 | 2 | 4 | | 14 | Madurai | 2 | 14 | 16 | | 15 | Nagapattinam | 2 | 0 | 2 | | 16 | Namakkal | 2 | 4 | 6 | | 17 | Perambalur | 1 | 1 | 2 | | 18 | Pudukottai | 2 | 1 | 3 | | 19 | Ramanathapuram | 1 | 0 | 1 | |  | |  |  |  |  |  | | --- | --- | --- | --- | --- | | **S. No.** | **District** | **Govt** | **Pvt.** | **Total** | | 20 | Ranipet | 1 | 2 | 3 | | 21 | Salem | 3 | 11 | 14 | | 22 | Sivagangai | 2 | 0 | 2 | | 23 | Tenkasi | 1 | 0 | 1 | | 24 | Thanjavur | 1 | 4 | 5 | | 25 | The Nilgris | 2 | 1 | 3 | | 26 | Theni | 1 | 0 | 1 | | 27 | Thirupathur | 1 | 0 | 1 | | 28 | Thiruppur | 1 | 3 | 4 | | 29 | Thiruvallur | 2 | 3 | 5 | | 30 | Thiruvannamalai | 2 | 0 | 2 | | 31 | Thiruvarur | 1 | 0 | 1 | | 32 | Thoothukudi | 1 | 3 | 4 | | 33 | Tirunelveli | 1 | 5 | 6 | | 34 | Trichy | 1 | 10 | 11 | | 35 | Vellore | 1 | 3 | 4 | | 36 | Villupuram | 2 | 0 | 2 | | 37 | Virudhunagar | 1 | 1 | 2 | |  | **Total** | **67** | **153** | **220** | |

**Figure 4: Month wise – Increase in RT-PCR Labs in Tamil Nadu**

*Source: Media Bulletin, Health and Family Welfare Department (Graphs prepared by authors)*

***Figure 5: COVID-19: Percentage share of Govt Free Test (including those covered under insurance) vs Paid Testing in Private)***

*Source: State Control Room, Health and Family Welfare Department (Graphs prepared by authors)*

**The logistics of testing:**

The other major reason why the state could go up to such a high frequency of testing, is because of its excellent public health logistics. The Logistics and supply chain management for these facilities were effectively managed by the Tamil Nadu Medical Services Corporation Limited (TNMSC), which got established way back in 1995.

The challenge is to maintain 67 well dispersed laboratories with the necessary kits, and a number of auxiliary consumables in required quantities, though there would be wide differences in utilization between them. Tamil Nadu’s ability to manage this logistics challenge rests a lot on its famed institution- the Tamil Nadu Medical Services Corporation which was able to ensure uninterrupted and adequate supply of nasal swabs, Viral Transport Medium (VTM), Extraction Kits, RT-PCR Kits, reagents, and other consumables. The TNMSC has so far procured and supplied 86.95 Lakhs kits as on Nov 30th 2020. These testing kits, and the equipment were new products with limited manufacturers and one had to have transparent procurement that brought in high quality of test kits, but at very low procurement costs since the entire testing expenditure was being borne by the state.

**Technology Choices adopted in Government RT PCR Labs**

In addition to the establishing of new labs, the other key factor which ensured the success of the testing strategy implemented through public institutions is the choice of technology choices adopted by TNMSC. The first was the drive to automate all the government labs for the RNA extraction process, since this was the most time consuming part of the testing cycle. This was achieved by ensuring that automated extractors were installed in all labs and today, no government lab does manual extraction. This helped to eliminate employee fatigue and the state to sustain high testing for months. Second was the insistence of performance parameters for RT-PCR kits with strict adherence to international quality norms as well as assay time of 45-50 minutes. This resulted in helping the state government to drastically reduce the dependence on private labs.

The above strategy has a significant economic angle too, considering the difference in cost of testing between the ramped up public institutions’ capacity and Tamil Nadu’s well developed private sector. At present, even after multiple reduction mandates by the state government, the prescribed rate for RT-PCR testing of government samples in Tamil Nadu’s private labs is Rs. 1200 as against Rs. 360 by government labs (but given fully free of cost for patients). This includes the additional costs of usage of automated RNA extraction and kits with international certifications. Even if the initial costs are capitalized, the cost per test is likely to be only around Rs. 400. The above cost saving has been the primary factor is Tamil Nadu standing up and sustaining its ‘only RT-PCR testing strategy’.

TNMSC also made the technology choice to opt for open systems of hardware, which are compatible with diverse consumables rather than closed system, which offered higher throughput at higher recurring costs. To improve throughput in such open system hardware, equipment were supplied to automate the crucial steps in testing. Also, the orders for such hardware supply were strictly tied to guarantees of consumable supplies.

**Access to Therapeutics**

Tamil Nadu’ health system has been described as one of the better health systems in the country with a much better performance on many key health indicators (5). The Directorate of Public Health and Preventive Medicine functioning since 1923 has the experience of both public health and the organization of both primary healthcare and hospital services. Its position with respect to health professionals is relatively better than other states.

One of the challenges that even good health systems face in responding to the COVID 19 pandemic is the huge expansion of hospitalization capacity that is required. Though increased number of beds and staff is often what is most visible, equally important is the supply chains that are required for ensuring that the necessary equipment and consumables are in place.

The presence of an innovative public institution like Tamil Nadu Medical Services Corporation (TNMSC) made a huge difference to Tamil Nadu’s health systems preparedness to respond to this pandemic. The TNMSC has a good reputation built over two decades of how a highly effective and efficient supply chain management can be ensured for delivery of public services where all drugs and diagnostics are provided free to patients. Its success had been attributed to its relative autonomy that enables a professional leadership to develop and provides considerable operational flexibility, a high level of transparency, its negotiation of rates and fixing of rate-contracts, and processes that make drug distribution responsive to changing demand patterns. This flexibility, helped TNMSC take swift action, and even before the pandemic wave reached Tamil Nadu, in February 2020, the TNMSC had done a stocking in the district warehouses of all essential drugs required in each district for the next six months, anticipating supply chain disruptions considering the fact that the epidemic was then centred in China and China was the principal supplier of APIs to India’s generic drug industry. Further, in March 2020, faced with the challenge of ordering a number of new products, the TNMSC has adopted the 16 (A) clause of the Tamil Nadu Tender Transparency (TT) Act which suspended key provisions of the Act as is permissible during natural calamities and emergencies and thus was able to do rapid procurement of essential new drugs, consumables and equipment in the changed supply side conditions- where there were few or no providers. The TNMSC took it on itself to forecast the demand under the changed circumstances, and procured medicines in anticipation of formal orders and payments. On some commodities the TNMSC made up to 50% advance payments, so as to ensure its supply as against the usual practice of full payment only after delivery. When those rate-contracted firms ran out of supplies, TNMSC could go to the next available supplier and negotiate the next best deal. To ensure cash flows, interest free advances were also issued against indemnity bonds so that the vendors down the supply chain get the confidence. There were further challenges in procuring items from other countries, and diplomatic channels had to be leveraged to ensure quality supply.

Another major challenge was the supply of medical oxygen. The TNMSC estimated requirements for three types of supply: liquid medical oxygen tank capacity for the tertiary care institutions and other large public hospitals, D type bulk cylinders for all institutions and B type cylinders for emergency use in Covid Care Centres (CCCs). In addition it also provided for a large number of portable oxygen concentrators as back-up. The supply chain mechanism was able to ensure that no oxygen bed went short of oxygen when they required it. In March, when the pandemic broke both public and private sector had almost equal liquid medical oxygen capacity- about 355.1 kilo litre in public and 314.6 kilo litre in private. By October this had increased to 519.4 in Public sector, whereas it remained stagnant in the private sector. The plan is to enhance this to 834.11 KL and works are on to achieve this capacity. Type D cylinders deployed rose from 4649 to 6649 and Type B cylinders capacity from 4893 to 6543. Such rapid increase in capacity required close collaboration with all the concerned government departments and the private manufacturers and distributors.

The number of “oxygen beds” (including ICU beds) increased from less than 300 in March 2020 to approximately 22,000 in October 2020 in public facilities. Similarly, the number of Ventilators currently in public facilities reached nearly 6000 numbers, wherein more than 50% of procurement was done during last eight months. The number of High Flow Nasal Cannula (HFNC) and Continuous Positive Airway Pressure Therapy (CPAP) in the facilities during March 2020 was 85 and 124 respectively and it was increased to 2164 and 201 respectively by October 2020. The entire procurement and installation of the equipment with all the necessary consumables for this was again the work of the TNMSC.

There were also no pricing issues in Tamil Nadu public health system since the government had a clear commitment to provide all these hospitalization services free of charge-including the medication, and diagnostics and ICU bed charges. Rate contract for all drugs was finalized by TNMSC and the requirement of each district was directly delivered to dedicated district warehouses. To avoid disruptions in availability, a model of regular releases to institutions was also formulated by TNMSC. The entitlement of each health institution was fixed based on its bed strength and cases. The institutions were allowed to lift the items once in every two days from the warehouses without any payment, by accounting all the COVID-19 related supplies as of zero value and not linking them to their corresponding regular budgetary allotments.

TNMSC ensured adequate availability of special high end drugs such as Tocilizumab Injection, Remedesivir, Enoxaparin Injection for the management of COVID-19 in all Government Medical Institutions throughout the State by adopting a streamlined and centralized procedure for the procurement, storage and distribution. To counter the challenges that may arise during the procurement and supply of the drugs, a competitive pricing was offered to the companies for the procurement. A recent Government report states that as of Nov 15th 2020, TNMSC has supplied 4,63,344 vials of Remdesivir Inj and 8,31,969 vials of Enoxaparin Inj and 2047 of Tocilizumab Inj. Dexamethasone of course was already part of the government supply chain.

Since the scientific understanding and clinical management of the pandemic keep on evolving day by day, procurement policies also needs to be tuned in such a manner to ensure supplies in the sellers’ market. TNMSC continuously followed USFDA approvals and other developments on therapeutic applications in this regard. Early large scale adoption of Remdesivir, cautious adoption of Tocilizumab and avoiding Faviperavir, installing CT scans earmarked for COVID patients etc. were few successful examples in this regard on how TNMSC has done evidence based procurement planning.

**The course of the Pandemic in Tamil Nadu**

Eight months after the start of the epidemic, the transmission curve is currently showing a downward trend in the State. There are many reasons for Tamil Nadu’s relatively good performance. But what we highlight in this paper is how rapid scaling up of access to testing and to appropriate therapeutics requires robust public procurement systems for drugs and diagnostics to be already in place. Also in a context where the entire treatment has to be provided without any user fees, a good public procurement agency for drugs and diagnostics brings value for money. TNMSC officials claim that Tamil Nadu has managed the lowest rate in the country for all the consumables in use, while ensuring quality assurance and deploying the best technology options. This is one reason why Tamil Nadu has been able to reach one of the highest levels of testing and institutionalized care for COVID 19 in the country.

COVID-19 has exposed both the vulnerabilities and opportunities in public health systems. One measure of the success of any public service institution is gauged on its efficiency, responsiveness and resilience, when faced with a crisis. The Tamil Nadu experience shows that public trust in public health institutions is still intact. It validates the understanding that investing in public institutions is essential for responsiveness to pandemics and other public health emergencies. And further that a robust public health procurement and logistics system is an essential element of building both trust and resilience in public health services. These are lessons for every state. But states like Tamil Nadu should go further and also invest in developing domestic manufacturing capacity and building the innovation ecosystems required for necessary medical products- including vaccines, diagnostics, devices, vaccines and personal protective equipment.

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**Note:**

1. Most of the data mentioned in the paper is from the Daily Media Bulletins published by Health & Family Welfare Department, Tamil Nadu.
2. The data on TNMSC procurement of drugs, diagnostics, Oxygen Capacity, Beds, Ventilators etc. was obtained from Internal Reports from TNMSC and the Health & Family Welfare Department, Tamil Nadu.

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