

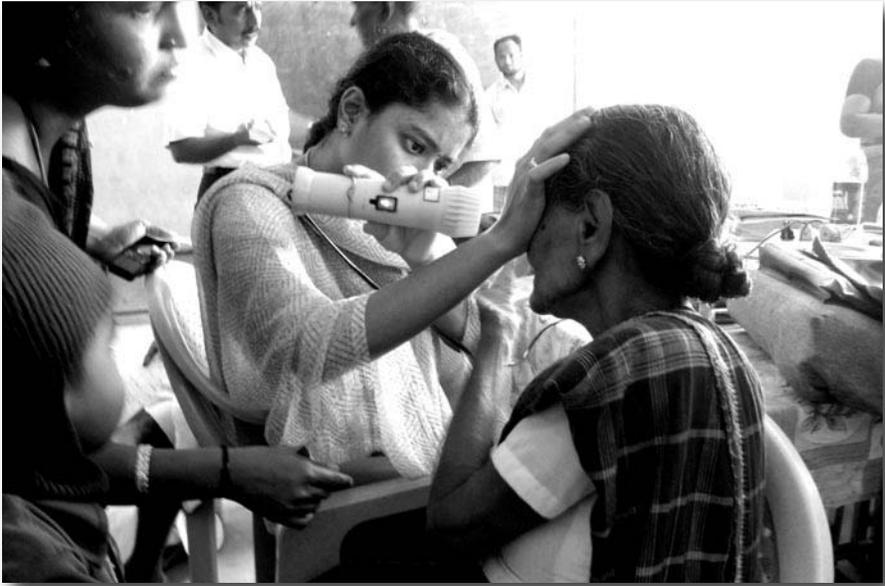


Chapter 6

TAMIL NADU 1980s–2005: A SUCCESS STORY IN INDIA

VR Muraleedharan¹, Umakant Dash¹ and Lucy Gilson²

1 Indian Institute of Technology, Madras, 2 LSHTM and University of Cape Town



© 2009 Robyn Iqbal, Courtesy of Photoshare

A volunteer optometrist examines a rural women for signs of glaucoma using basic instruments at a mobile medical camp in Tamil Nadu. Such mobile camps are often the only medical care and treatment that rural Indians receive each year. The vision camps are held annually in many small towns and villages as a programme which offers free eye examinations and treatment of basic vision problems.

■ Key messages

- Tamil Nadu has made great progress in improving maternal, newborn and child health, performing consistently above the Indian national average.
- The Government of Tamil Nadu has had a long-term commitment to improving primary care in rural areas. Primary health care centres have expanded access to health care, providing high-quality primary care and emergency obstetric and newborn care, among other services. The inclusion of indigenous medicine has increased use of public facilities.
- A stable bureaucracy and effective managers have ensured continuity and have formulated, implemented, evaluated and adapted government policies to improve health outcomes and equity. The state is unique in India in developing a strong public health management cadre at the district level.
- At the end of the 1970s, Tamil Nadu trained and deployed village health nurses to serve rural communities more rapidly than in most other parts of India. Since then, the range of primary care services they deliver has gradually increased. The impact of this initiative on key health indicators has been clearly documented, for example through increased numbers of antenatal care visits and institutional deliveries in rural areas.
- Another innovation was the launch of a new drug distribution system in 1995 that rationalized the purchase and distribution of medicines to all public hospitals and primary health care centres. Performance reviews attest to its impact in improving the overall effectiveness of the health delivery system in Tamil Nadu.
- Since the 1990s, Tamil Nadu has had one of the most rapidly expanding private health sectors in India. Some joint public–private engagement has occurred, including health awareness raising campaigns, the contracting out of services such as laboratory diagnostics, and some corporate support for primary health care facilities. By focusing on the public sector, the Government of Tamil Nadu has been able to ensure that people have access to lower-cost alternatives to private sector health services.
- Other factors that have contributed to better health outcomes include a lower fertility rate, improved gender equality, a higher literacy rate, economic growth, rapid industrialization and improved infrastructure.

■ Introduction

With a population of 72 million, Tamil Nadu is larger than many countries¹. It is the eleventh largest state in India by area and the seventh most populous. Most of the population, 88%, is Hindu, with Christians and Muslims constituting 11%, and other religions 1% (2008) (Box 6.1). Children under 15 years of age make up 27% of the population and 64% are aged 15–60 years. Administratively, the state has been divided into 32 districts, with approximately 45% of its population living in urban areas. Chennai (formerly known as Madras) is the state capital. The services sector makes up 45% of the economic activity in the state, followed by manufacturing (34%) and agriculture (21%).

Economically, Tamil Nadu is relatively prosperous. It ranks third among all states in India, with an average per capita income in 2007 of Rs 32733 (Int\$3522), which is substantially above the national average. Both its literacy rate and its Human Development Index (HDI) are also significantly above the national average, as are several other socioeconomic indicators (Table 6.1). Total fertility rate reached a replacement level of 2.1 in the early 1990s, far ahead of most other states in India. Life expectancy at birth for men and women is high compared with the rest of India, and maternal, newborn and child mortality rates are among the lowest in the country.

Typically, the public health care system in India delivers modern medical services. This is true of Tamil Nadu as well, but there has been a conscious effort by the state also to provide indigenous medical services through primary health care centres. The Government of India has promoted various indigenous approaches to medicine, mostly through supporting research on them, and less through delivery of services in public facilities.

Most health spending (about 4% of state GDP) is from private sources, largely from people paying for consultations and treatment out of their own pockets. The private sector has expanded rapidly in cities, towns and rural villages since the 1980s, and now accounts for 80% of outpatient and 60% of inpatient care. Although there are few empirical data, the available literature suggests that a number of factors have encouraged the growth of the private sector in India. These include, for example, the inability of public institutions to cater to growing health care needs; huge private investment in the medical industry; a lack of appropriate regulation and regulatory bodies; and the interests of a vast network of indigenous medical practitioners, particularly in rural parts of the country¹⁴.

Nevertheless, the state plays a significant role as a provider of health care services. The Government of Tamil Nadu spends about 1% of state GDP on health,

Box 6.1 Tamil Nadu at a glance

<i>Population</i>	72 million ¹ . India's 11th largest state by area and 7th by population. 48% of the population is urban ² .	
<i>Geography</i>	Located at the southernmost tip of India. Long coastline. Highly dependent on monsoon rains, with drought when they fail.	
<i>Ethnic composition</i>	88% Hindu, 11% Christian or Muslim, 1% other ² .	
<i>Government</i>	One of 28 states in the Federal Republic of India. India gained independence in 1947, and the current state boundaries and name date from 1969. State elections every five years, but despite changes in political leaders and parties, commitment to strengthening public health and equity has been constant.	
<i>Health system</i>	Health expenditure per capita (public) ³ : Rs 223 (Int\$5.06) ^a Health expenditure per capita (private) ³ : Rs 1033 (Int\$23.48) ^a . Density of physicians, nurses and midwives per 10 000: 12.3 ⁴ . Emphasis on improving primary health care, extensive use of multipurpose workers, as well as services for women and children. Focus on equity. Rapidly expanding private sector. Coverage of key interventions is high (90% deliveries with skilled attendance ⁵ , 92% of infants fully immunized) ⁵ .	
<i>Economic, demographic and social development indicators</i>	GDP per capita (constant 2005 Int\$) ⁶	3522
	Economic growth: higher and poverty reduction faster than the India average in the 1990s ⁷ .	
	Population living on less than \$1.25/day	–
	Gini index ⁸	28.3
	Infant mortality rate (2007) ⁹	35 ^b
	Maternal mortality rate (2004–6) ¹⁰	111 ^c
	Adult HIV prevalence rate (aged 15–49) ¹¹	0.25%
	Life expectancy (2001–6) ⁹	67 (men) 69.8 (women)
	Total fertility rate (2006) ⁹	1.7
	Literacy rate (2011) ¹	80%
	Ratio girls to boys in education ^d (2005–6) ⁵	0.94
	Access to improved water source (2005–6) ⁵	93.5% households
	Internet usage per 100	–

Note: ^aAt 2005 exchange rate; ^bPer 1000 live births; ^cPer 100 000 live births; ^dPrimary and secondary education.

which is similar to most other states in India, although very low by international standards. Although we recognize that people's access to private health services is likely to have had a significant impact on health outcomes in Tamil Nadu, this chapter focuses on government health policies and actions, and how public funds have been used to attain greater health gains than have been achieved by almost all other states in India.

Table 6.1 Comparative health indicators across major states of India, most recent year available

States/ India	GDP PPP per capita in US\$ (2009) ⁶	Total fertility rate (2006)	Infant mortality per 1000 live births (2007)	Life expectancy at birth (years) (2001–6)		Under-5 mortality per 1000 live births ¹³ (2006)	Maternal mortality per 100 000 live births (2004–7)	Full immuniza- tion (2002–4)
				Male	Female			
Andhra Pradesh	3197	2.0	54	62.8	65.0	87.7	154	62.9
Assam	1875	2.7	66	59.0	60.9	85.0	480	19.3
Bihar	1068	4.2	58	65.7	64.8	84.8	312	24.4
Gujarat	3849	2.7	52	63.1	64.1	60.9	160	57.7
Haryana	5386	2.7	55	64.6	69.3	52.3	186	62.9
Karnataka	3244	2.1	47	62.4	66.4	54.7	213	74.1
Kerala	3854	1.7	13	71.7	75.0	16.3	95	81.2
Madhya Pradesh	1692	3.5	72	59.2	58.0	94.2	130	32.5
Maharashtra	4288	2.1	34	66.8	69.8	46.7	335	74.3
Orissa	2303	2.5	71	60.1	59.7	90.6	303	55.1
Punjab	4133	2.1	43	69.8	72.0	52.0	192	75.3
Rajasthan	2110	3.5	65	62.2	62.8	85.4	388	25.4
Tamil Nadu	3522	1.7	35	67.0	69.8	35.5	111	92.1
Uttar Pradesh	1462	4.2	69	63.5	64.1	96.4	440	28.1
West Bengal	2839	2.0	37	66.1	69.3	59.6	141	54.4
India	2930	2.8	55	64.1	65.4	74.3	254	47.6

Sources: References 6, 12 and 13.

This chapter presents a historical perspective on Tamil Nadu's pursuit of better health, focusing on the period from 1980 to 2005^a. The late 1970s and early 1980s is a clear landmark for beginning the analysis, as this was when the rural health care delivery system was restructured as part of the commitment to the 1978 Alma-Ata Declaration about universal access to primary health care. Health gains and their assessment are included only up until 2005 because this is when the National Rural Health Mission was launched. This flagship programme of the Government of India, in collaboration with state governments, has already resulted in a number of architectural changes in the functioning and management of public health care facilities in rural regions of the country. There has been a substantial increase in funding to state governments to implement the programme, which is expected to lead to further improvements in health. Although it is too early to draw meaningful conclusions, its impact is beginning to be seen in a variety of ways.

The chapter highlights progress in improving health outcomes in Tamil Nadu, followed by a description of the supportive structures, policies and individuals that have been critical in strengthening the public delivery system. It then explains the most significant health policies and interventions to be implemented in the 1980s and 1990s, analysing the impact that these policies had on usage and the extent to which the poorest population groups have benefited. Next, it flags the possible contributions of certain larger socioeconomic and cultural factors. The chapter concludes with a set of lessons derived from Tamil Nadu's experience, which may be useful to other governments seeking to improve the health of their people.

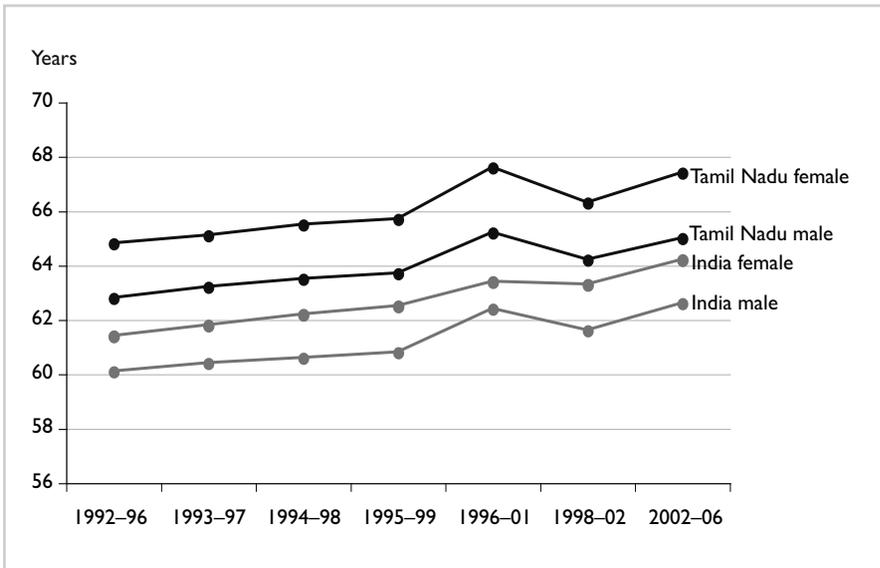
Better health?

Table 6.1 and Figures 6.1–6.4 show that the relative position of Tamil Nadu on a range of health indicators has been much better than the average for India.

Between 1980 and 2005, the infant mortality rate in Tamil Nadu decreased by 60%, compared with 45% for the country as a whole. The decline was even more significant in rural areas of the state, and by 2005, infant mortality was only slightly lower in urban areas (Figure 6.2). Even though the infant mortality rate fell throughout the entire country of India between 1971 and 2005, the female–male differential in the infant mortality rate actually increased with the notable exception of Tamil Nadu, which showed the lowest gender disparity during this period¹⁶.

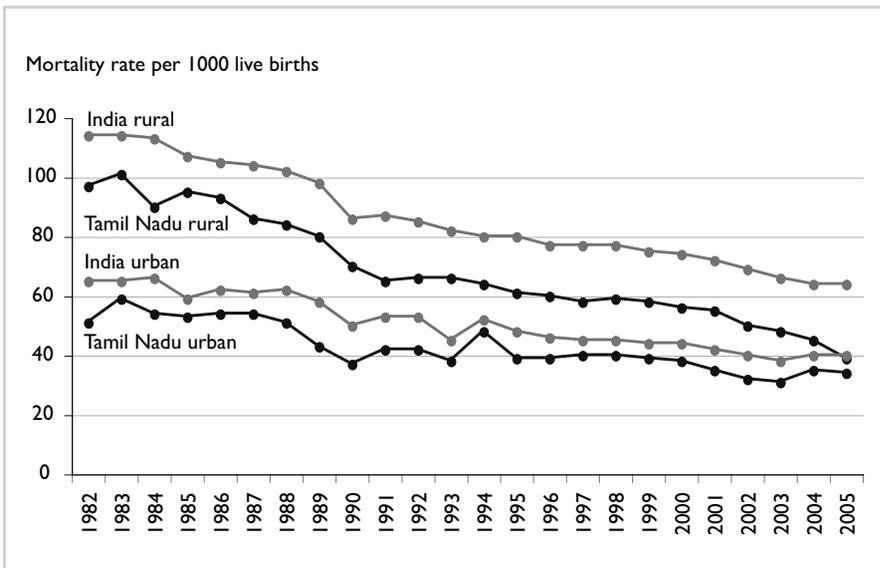
^a See Chapter 2 and Annex for an explanation of the methodology and data sources.

Figure 6.1 Life expectancy (male and female) in Tamil Nadu and India, 1992–2006



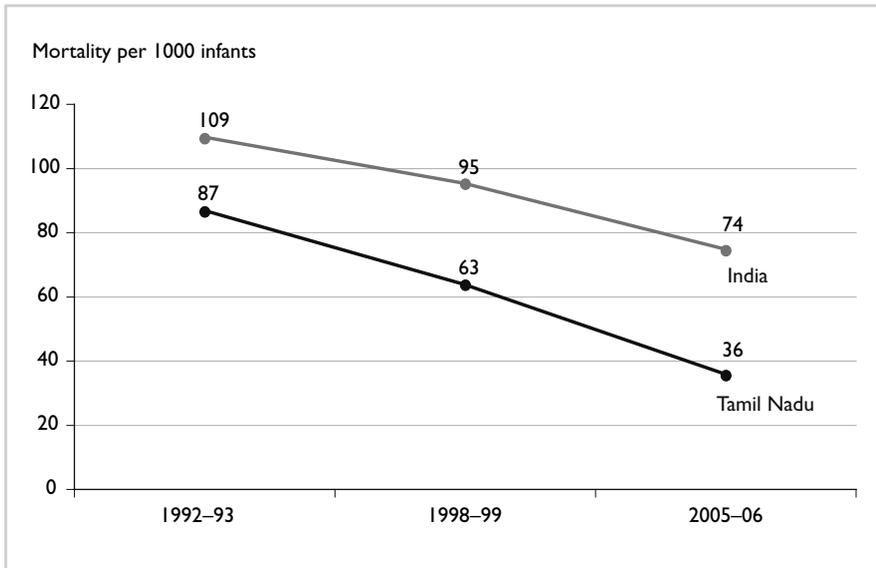
Source: Adapted from reference 9.

Figure 6.2 Infant mortality rate in Tamil Nadu and India (rural and urban), 1982–2005



Source: Adapted from reference 9.

Figure 6.3 Under-5 mortality rate in Tamil Nadu and India, 1992–1993, 1998–1999 and 2005–2006

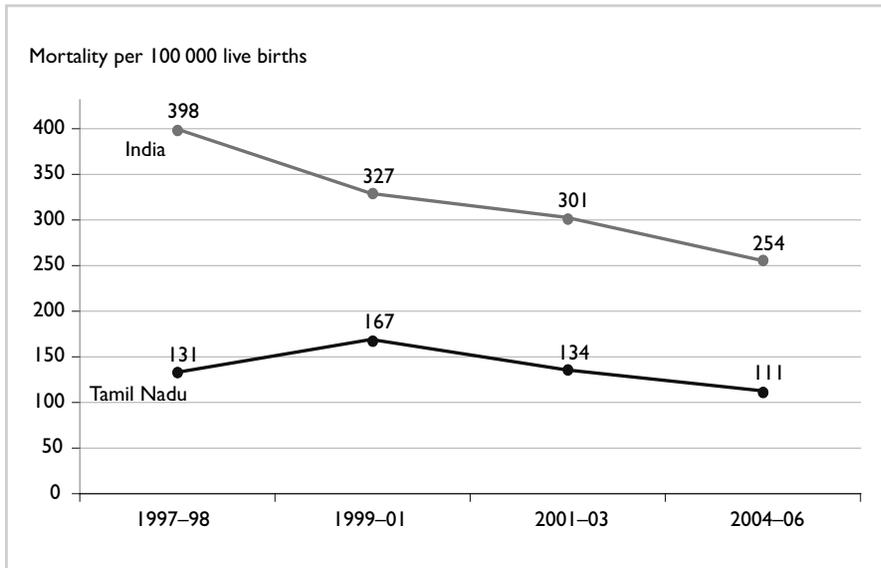


Sources: Adapted from references 5, 13 and 15.

By the mid-1990s, nearly 23% of infant deaths were due to premature births and low birth weight. Asphyxia and birth injuries accounted for another 23%, while diarrhoea and acute respiratory infections accounted for 6% and 17%, respectively¹⁷. In the absence of periodic and regular reporting on these causes, it is not possible to comment on trends over the years.

The under-5 mortality rate in Tamil Nadu fell by 53% between 1992–1993 and 2005–2006, compared with 32% for the country overall (Figure 6.3). In 2006, Tamil Nadu had the third lowest rate of under-5 mortality in India, with 35.5 deaths per 1000 live births in contrast to an average of 74.3 for India.

However, the most dramatic difference between Tamil Nadu and the rest of India has been in the number of women who die as a result of pregnancy or giving birth. Between 1982 and 1986, the maternal mortality rate in Tamil Nadu was estimated at 319 deaths per 100 000 live births, compared with a national average of 555 (ranging from a high of 1028 in Assam to a low of 235 in Kerala)¹⁸. By 2004, the maternal mortality rate in Tamil Nadu had dropped to 111 deaths per 100 000 live births, less than half of India's average of 254 and the second lowest in the country (Figure 6.4)¹⁰.

Figure 6.4 Maternal mortality rate in Tamil Nadu and India, 1997–2006

Source: Adapted from reference 10.

Since 1980, the Health and Family Welfare Department of the Government of Tamil Nadu has reported reductions in poliomyelitis, tuberculosis, malaria, leprosy, whooping cough, measles and typhoid. Guinea worm disease was practically eliminated by the mid-1980s¹⁹ and no polio cases have been reported in the state since 2000, in contrast to some other parts of the country.

The state has achieved better than average results in implementing the Blindness Control Programme, which is funded by the Government of India. For example, in 2003, Tamil Nadu led the country in the number of cataract operations performed (592 per 100 000 population) and the prevalence of blindness due to cataracts was reduced from 1.13% in 1994 to 0.40% in 2002, while the national average only fell from 1.19% to 0.70% during the same period.

The next two sections discuss how political leadership, committed civil servants and good management practices, as well as specific policies and interventions from within the public health system, have contributed to significant improvements in health outcomes.

■ **How has Tamil Nadu achieved this? The importance of leadership, commitment and good management in improving health**

The commitment by and insight of government leaders in Tamil Nadu have made a significant contribution to the health gains in the state. Even though political leaders and parties in power have changed over the years (elections are held every five years), two aspects of the government's approach to strengthening the public health system have remained consistent since the early 1980s. First, health policies and government spending on health have emphasized improving primary care services, especially in rural, poor and disadvantaged communities. Second, political leaders have been committed to implementing innovative interventions, some of which are common across all states and funded by the central government, efficiently and effectively.

The Government of Tamil Nadu has prioritized and invested resources in primary health care, particularly for services benefiting women and children. The state's total health budget increased dramatically, from Rs 4108 million (US\$ 167.9 million) in 1991/1992 to Rs 14 870 million (US\$ 335.9 million in 2005/2006)²⁰. In nominal terms, spending increased by 3.6 times between 1993/1994 and 2005/2006. Medical, public health and family welfare is the second-largest expenditure category in the state, next to education. Since 1990, central government has contributed approximately 20% of the state's annual health budget and the Health and Family Welfare Department of Tamil Nadu has consistently spent about 45% of its annual budget on primary health care. In Tamil Nadu, the tertiary sector's share of the budget fell from 33% in 1990 to 24% in 2002, and the secondary sector's share increased correspondingly during the same period. There are no hard data for other states, but most health officials and former health secretaries in the national government who were interviewed by the research team reported that the overall share of resources devoted to primary care within the health sector budget was not as high in other states as it was in Tamil Nadu (interviews conducted by the authors with various state officials who had managed many national programmes, and two former health secretaries in Delhi, 2010).

It is widely accepted among people interviewed as part of this study, especially those working at the central government level who were implementing common programmes in different states, that Tamil Nadu's health sector has benefited from a number of committed health secretaries who have been the drivers of the innovative initiatives discussed in the next section. The vigorous support for maternal and child care in the late 1990s and early 2000s was particularly due to the vision, commitment and leadership of senior civil servants. One example

was a determined campaign by one health secretary and the Government of Tamil Nadu against female feticide in the late 1990s, making effective use of the media to generate public support for reform. The importance of the state's political and bureaucratic commitment to bridging gender differentials in mortality has received some scholarly attention^{16,21}.

The presence of civil servants with management skills and sufficient power and discretion to implement reforms has been an important factor in promoting continuity of policy. Bureaucratic leaders made use of modern public management methods, giving greater autonomy to agencies within the public sector²⁴. The creation of quasi-governmental organizations has proved to be an effective mechanism for overcoming tardy bureaucratic producers²³. This is well-documented in the case of the Tamil Nadu Medical Services Corporation (see below), an autonomous body managing drug procurement that has been able to implement a series of measures to improve the quality of drugs and promote rational drug use.

Other features of the process of implementing health policies that were considered important at national level are flexibility and the ability to learn lessons. There seemed to be a recognized need for central leadership and strong institutions, as well as for bottom-up innovation to ensure that policy changes translated into improved access to health services. For example, many district health authorities were immune to shifting political and state priorities and had the autonomy and flexibility to plan immunization campaigns and other primary health care initiatives, attracting support from charitable bodies where necessary.

Another example relates to efforts to reduce maternal deaths. Tamil Nadu district officers were given the authority to develop local solutions to problems that emerged from maternal death reviews, and successful local strategies were replicated in other districts. In parallel, there were collaborative processes at state level, such as the development of evidence-based guidelines to standardize treatment for potentially life-threatening complications during childbirth across the state.

Tamil Nadu is the only Indian state with a distinct public health management cadre at the district level. Everyone interviewed identified this as a vital component of effective management of the health delivery system. Most states eliminated their public health management cadre after independence in 1947, but Tamil Nadu retained it and put the staff in charge of managing primary health institutions. The staff undergo a series of training programmes in public health and allied subjects, including in managerial skills. They are also expected to qualify for a diploma in public health, which enables them to move up the career ladder. A major advantage of the public health cadre is that it provides managerial continuity at district and higher levels of primary health care, and a

forceful argument to this effect has been made recently²⁴. Most interviewees said that this continuity was critical for following up issues at various levels.

The Tamil Nadu state had a much better combination of managerial skills at various levels, from state secretariat to district health system and even below. In my six years of association with this sector, I would say no other state could boast of having such a blend of professionals. I would even say that, overall, the administrative efficiency of the state health system is far higher than that of other states of India.

*Former Secretary of the
Ministry of Health and Family Welfare of the Government of India*

The presence of this cadre meant that managers were able to act quickly because they were familiar with the issues, and over time had developed a good understanding of the best ways to deal with them. Managers in other states where no public health management cadre exists are frequently transferred from one department to another within the health sector. Consequently, they are often slower to act, as it takes them longer to grasp the situation on the ground.

The combination of experienced managers at all levels of the state health system, and the greater autonomy they had, resulted in speedier allocation and more effective use of resources at facility level, thus enhancing access to health care (as will be described below). Greater access implied better protection from conditions that lead to adverse health outcomes.

The examples in the next section illustrate why Tamil Nadu has a reputation for having made more effective use of the resources it receives from the central government and for having spent resources more efficiently in comparison with most other states, a point that was made by several officials during interviews conducted by the research team.

■ **What did Tamil Nadu do to improve health (1980–2005)?**

Together, four complementary actions by the Government of Tamil Nadu during the 1980s and 1990s made a significant contribution to improving health, especially the health of women and children in rural areas:

1. training and deploying a new type of village health worker;
2. building a network of primary health care centres;
3. scaling up immunization; and
4. developing an innovative drug distribution system.

This section is largely based on many interviews with former officials who served during the 1980s and the 1990s. Whenever possible, officially reported data are used to validate their views and observations.

Training and deploying thousands of village health workers

As part of a new strategy to deliver primary health care in rural areas, the Multipurpose Workers Scheme was launched by the central government in early 1980 with the goal that every rural community with a population of 5000 would be served by an adequately trained health worker. In Tamil Nadu, the multipurpose workers are all women and are designated as village health nurses. This new health worker role was created to work in the community and provide antenatal and postnatal care, vaccinations, contraception and other basic maternal and child health services during regular home visits. The village health nurses are required to keep complete records, for example of all pregnant women, and encourage women to give birth in a health facility rather than at home. To help synergize the work of various cadres and improve child health status, village health nurses are expected to work closely with community nutrition workers on the nutritional meal scheme, aimed at schoolchildren.

Tamil Nadu implemented the Multipurpose Workers Scheme faster than most other states by absorbing existing maternity assistants as village health nurses and opening nearly 60 schools to train thousands more. This had an immediate and significant impact on the manner in which primary care was deployed and delivered in rural areas. Invariably, interviewed officials highlighted this as a critical factor in improving health status.

Having completed 10 years of school, village health nurses are given approximately 18 months of training in basic primary health care. A great deal of emphasis was on imparting practical skills for better management of common conditions, such as acute respiratory infections and diarrhoea. By the early 1980s, approximately 2000 village health nurses were serving rural communities and by the late 1980s, nearly 8000 of them were in place across rural areas of the state. They have improved access to essential services at community and household level, and the range of available primary care services delivered by them has gradually increased. The impact of this initiative on key maternal and child health process indicators has been clearly documented. This can be seen, for example, through the increased number of antenatal care visits and institutional deliveries in rural areas.

Building a network of primary health care facilities

When the Multipurpose Workers Scheme was getting off the ground, the central government also launched an initiative to expand the number of primary health centres and health subcentres in rural areas. The plan was for primary health centres to provide primary care, including normal deliveries, outpatient care, care for minor accidents and vaccinations, as well as to manage school health programmes and various national public health programmes, such as those for tuberculosis and leprosy. A typical primary health centre would have four to six beds, and be staffed by one or two physicians, two nurses (with the title of auxiliary nurse and midwife) with wide-ranging roles, a pharmacist, a driver and one or two assistants, depending on local conditions. Administratively, each primary health centre would have four to eight health subcentres under its jurisdiction. Each health subcentre would have one village health nurse serving a population of 5000.

Tamil Nadu embraced the concept wholeheartedly and built the facilities much faster than almost all other states. The rate of expansion was remarkable. In the early 1980s, there were only about 400 primary health centres and 4000 health subcentres across rural areas of the state. By 1990, nearly 1400 primary health centres and about 8000 health subcentres had been opened and Tamil Nadu was very close to achieving the national target of one primary health centre per 30000 people and one health subcentres per 5000 people. Since then, these achievements have more or less been sustained. In 2005, Tamil Nadu had approximately 1500 primary health centres (one for every 33000 people) and 8680 health subcentres (each covering a population of 5100). Only two districts had fewer primary health centres and health subcentres than the national population norms. Very few states have reached this high level of coverage through the primary health care system.

With sustained financial support from the central and state governments and from development partners, primary health services continued to improve. Several development partners contributed to the expansion of health infrastructure in Tamil Nadu. Among them, the Danish International Development Agency (DANIDA) has been the most significant in strengthening primary care²⁵. DANIDA has had a presence in Tamil Nadu's health sector since the early 1980s. Although its annual budget has remained at around 1% of the total state health budget, a substantial amount has been channelled into constructing primary health centres and capacity-building exercises. DANIDA's commitment to primary health care demonstrates that development partners can make a positive, lasting impact on the system.

The rapid expansion of primary health centres was possible because of the speed and overall efficiency with which Tamil Nadu officials, compared with most other states, made use of the resources allocated from the central government. And unlike other states, innovative approaches were encouraged. In the 1990s, for example, nearly 400 primary health centres in rural regions of Tamil Nadu were constructed with in-kind contributions (in the form of labour) from local community members. An added benefit of such community participation was that it is judged to have improved utilization of the facilities.

The state government also made efforts to tap resources from industrialists by appealing to their philanthropic instincts to adopt health care institutions in their areas and make contributions towards maintenance and improvements. Since 1998, 20 different industrialists in Tamil Nadu have adopted more than 65 primary health centres and government hospitals^{26,27}. The Government of Tamil Nadu also encouraged members of the legislative assembly and members of parliament to make use of the Development Fund for the adoption and maintenance of primary health centres and hospitals in their constituencies. Contributions from industrialists were used for staff, medicine, equipment, civil works, the construction of staff quarters and the maintenance of buildings. Several medical officers noted that, in the long run, such forms of assistance could not be relied upon for operating the public health facilities, but that such assistance had helped them with overall maintenance and, even if temporarily, had visibly improved the upkeep of the primary health centres. A DANIDA representative stated that adoption of primary health centres by private corporate bodies in the 1990s has had a significant impact on the overall appeal of public facilities.

Another development was the concept of the 24-hour primary health centre, which was pioneered in 1996/1997 to offer outpatient care during evening hours and to increase women's access to routine essential and emergency obstetric care. Within two years, nearly 250 primary health centres were open around the clock, and by 2008, nearly all of the state's 1500 primary health centres had joined them. The range of services provided by the centres has also grown considerably over the years and now, for example, several centres offer advanced diagnostic services and dental care. Finally, the state also provides indigenous medicine and treatments in many public health care facilities. By the mid-1990s, indigenous physicians were present in 281 primary health centres, and in several hospitals too. This is believed to have increased access to services.

In order to ensure that the performance of primary health centres could be routinely monitored and, when necessary, followed up with remedial measures, the Department of Public Health with the help of DANIDA established a

monthly Institutional Services Monitoring Report System. Data on staff positions, vacancies, use of resources (such as beds and vehicles), services delivered (including inpatient and outpatient coverage, antenatal care, abortions, vaccines administered, and diagnostic laboratory tests conducted), types of delivery conducted, and so forth, are reported on a monthly basis for all primary health centres in the state.

Scaling up the immunization programme

A third successful intervention was the Universal Immunization Programme, which was rapidly scaled up across the country from 1986 with the support of UNICEF. The measles immunization campaigns that started in 1978 (with tremendous support from the Christian Medical College of Vellore, and vaccine supplied by the Rotary Club) had already had a major impact on child health. As part of the new programme, Tamil Nadu adopted a five-dose policy for polio vaccine (unlike other states, which had a three-dose policy), and significant improvements in child health followed (Jacob John, internationally recognized scholar and pioneer in the conception and design of the immunization programme in India, personal communication, August 2010).

By the early 1990s, Tamil Nadu ranked first among all states in India in the number of children vaccinated: 60% of children in rural areas and 75% of children in cities had been fully immunized, while only 6% of rural and 1.7% of urban children had received no immunization at all²⁸. By that time, the state had also achieved the lowest variation in full immunization rates between the richest and poorest quintiles and between rural and urban areas (although the former had a slightly higher level of inequality than the latter). The reduction in inequity due to income and geographical location was much greater in Tamil Nadu than in other states. In addition, differences in immunization coverage by gender, both in rural and urban areas, were the lowest in India. Mass campaigns were common and, in addition to the roles played by primary health centres and health subcentres, several community organizations, including local schools and Rotary Clubs, contributed to their success. Throughout the state, village health nurses and nurses at primary health centres administered vaccinations during regular household visits, as well as on set dates over the course of the year.

By the late 1990s, 99% of rural and 100% of urban children in the state had received some immunization, while 85% of rural and 91% of urban children had received full immunization²⁹. Evidence of overall health gains among children in the state was overwhelming.

The high level of immunization achieved in Tamil Nadu did not result from a

discrete vertical programme, but was the product of a long-term political process that gave high priority to maternal and child health, leading to the integrated expansion of primary health centres and broader behavioural and cultural change among policy makers and the general population.

Ensuring a reliable supply of essential drugs

The most innovative development conceived by the Government of Tamil Nadu was the creation of the Tamil Nadu Medical Services Corporation (TNMSC), established in 1995 as an autonomous body to purchase and distribute medicines to all public hospitals and primary health centres.

This was a far-sighted vision of the then health secretary (in 1996) who had to face difficult moments as it involved huge amounts of money and the interests of many stakeholders. The state had earlier suffered from serious defects in the public eye, due to abuses of power and corruption in the drug purchase system, which had to be weeded out. The reputation of the present drug system actually helped build the overall reputation of the health delivery system

Former district official, Tamil Nadu^b

Drugs overall have accounted for about 15% of the state health budget since the 1990s. Prior to the formation of TNMSC, health facilities under the jurisdiction of various departments purchased drugs on their own, with funds that came directly from one of three directorates: Medical Education, Medical and Rural Services, or Public Health and Preventive Medicine. There were persistent complaints about the misuse of funds, with frequent misappropriation of non-essential drugs and high distribution costs. Stock-outs of essential medicines were common across government health institutions at all levels. Once TNMSC was established, the three budgets were combined for drug procurement and the state's drug list was reduced to approximately 250 drugs, all generic.

Under the new system, medicines procured by TNMSC through an open-tender process are delivered directly by suppliers to district warehouses. District officers are given fixed transportation allowances to transfer these drugs to hospitals and clinics. Although the government is able to predict overall consumption within the state very well, district and subdistrict level consumption is highly variable

^b This is a widely shared and accepted view of those in civil service, particularly among those in federal (central) government services who are able to compare the effectiveness of various states that implement common programmes.

and so all health care institutions (including primary health centres) are given considerable leeway in deciding which drugs they need and in what quantities. In return, all facilities are required to keep up-to-date records of their stocks and utilization. TNMSC regularly inspects district warehouses and storage facilities. It does not have its own laboratory facilities but hires the services of reputable private laboratories for quality testing.

Although its performance has yet to be evaluated systematically, TNMSC's effectiveness is widely admired and it has helped many other states begin similar drug management systems. A detailed analysis of TNMSC was published in 2000²³ and a review published in 2008 assessed TNMSC's performance and its impact on improving the overall effectiveness of the health delivery system in Tamil Nadu³⁰.

TNMSC has a reputation for strict quality adherence, and for being very transparent and accountable. Its well-designed computer system allows for good control of the medicines stocked in district warehouses and for the movement of medicines to be accurately tracked. Such information is uploaded on to its website on a daily basis.

A reliable supply of high-quality medicines in primary health centres has led to increased patient satisfaction and has contributed to the overall increase in demand for services across the state at all levels of the public health system. There is also anecdotal evidence that TNMSC has driven down the cost of competing drugs in the private sector, for example by a fall in price of brand name drugs for the treatment of tuberculosis (former state tuberculosis official, interview, September 2010)³¹.

Once its success in managing the supply of medicines was firmly established, the scope of TNMSC was expanded to include other services. For example, its savings were used to purchase diagnostic equipment. All hospitals up to sub-district level were provided with technology for ultrasonography and other diagnostics. In later years, the government made a decision to equip all district hospitals with computer tomography scanners and a magnetic resonance imaging machine. The availability of this equipment in the public sector increased access and decreased the cost to patients, who might otherwise have sought services in the private sector or, in the case of the poor, gone without a proper diagnosis.

■ What else has Tamil Nadu done to improve health?

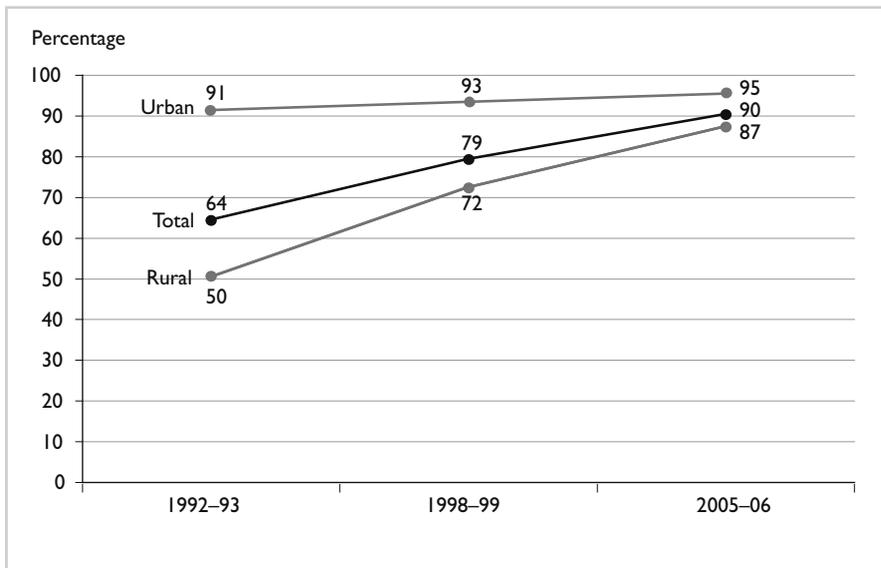
Services for women and children

The government's concerted efforts to train village health workers, build primary health centres and ensure they were adequately staffed, equipped and stocked with essential medicines and other supplies led to a marked increase in the use of primary health care services in Tamil Nadu, particularly by women and children and poor families from rural areas.

Several indicators of use of primary health care services in the public sector show significant improvements between 1990 and 2005. For example, almost all pregnant women received antenatal care in this sector: the proportion of women who received at least three antenatal visits increased dramatically from about 20% in the early 1990s to 95% by 2005³².

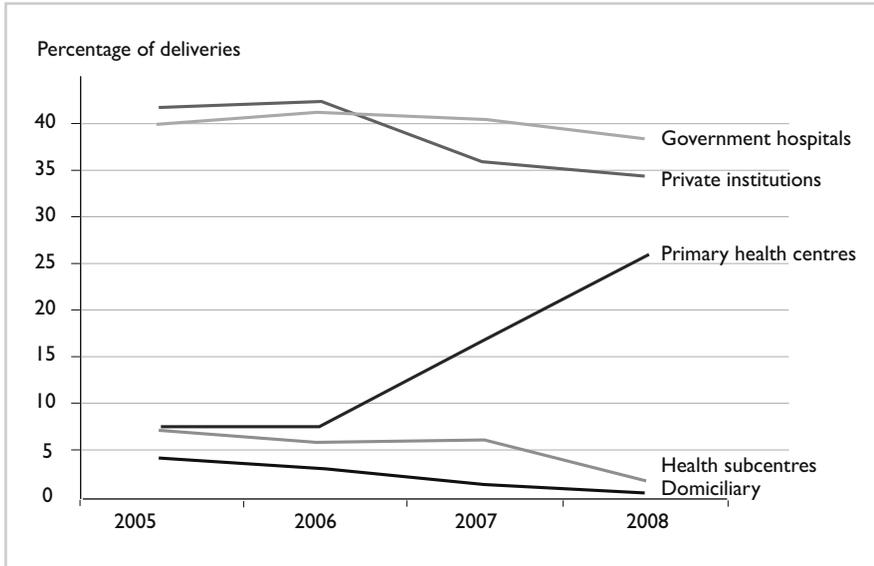
In the early 1970s, 80% of women gave birth in their homes. By the early 1990s, this number had fallen to 42% and by 2005, it was 10% (Figure 6.5). Recently (2005–2009), the share of total deliveries in primary health centres has increased to nearly 25% and in the same period there has been a reduction from 43% to

Figure 6.5 Proportion of institutional deliveries, Tamil Nadu, 1992, 1998 and 2005



Source: Adapted from reference 33.

Figure 6.6 Share of private and public institutions in total deliveries, Tamil Nadu, 2005–2008



Source: Adapted from reference 33.

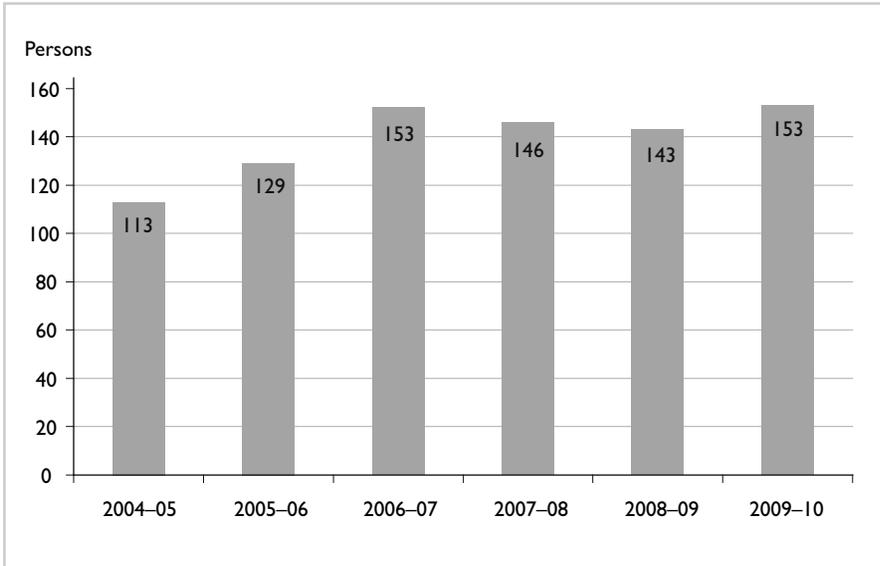
35% in the share of deliveries in private facilities (Figure 6.6). The beneficial effects of institutional delivery to bolster primary health care, along with other policy efforts, have led to a gradual but substantial fall in the maternal mortality rate.

As the following figures show, the average number of daily outpatient visits in primary health centres in Dharmapuri District (one of the least developed regions in the state) increased from 113 in 2004 to 153 in 2009 (Figure 6.7). Likewise, the average number of deliveries conducted per month in primary health centres increased more than three times over the same period (Figure 6.8).

Reaching the poorest

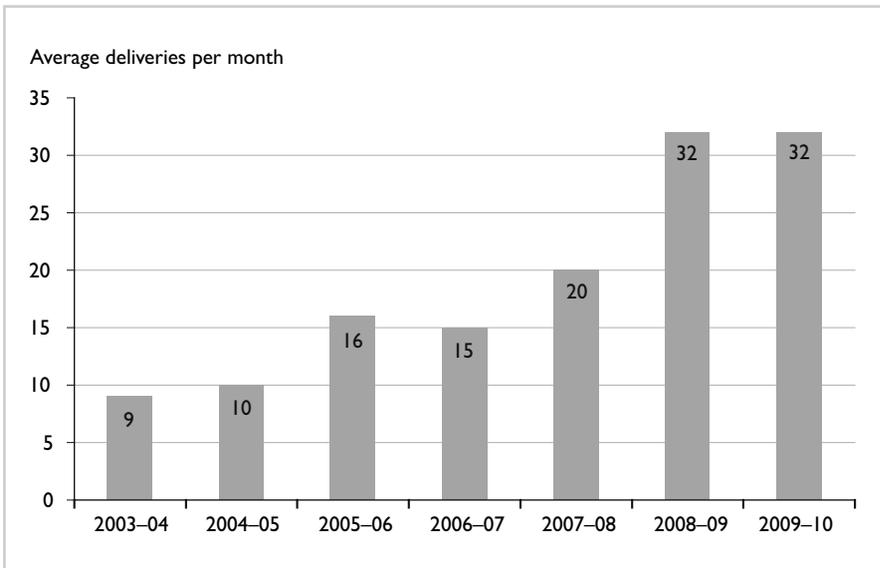
In addition to measuring the increased use of primary health services in the public sector, it is also essential to know the extent to which the benefits of public spending have reached the poorest in society. To put it differently, are the poor getting their fair share of the benefits of public spending on health care, in terms of higher use of health services and/or improved health status?

Figure 6.7 Daily outpatient attendance per primary health centre, Dharmapuri District, 2004–2009



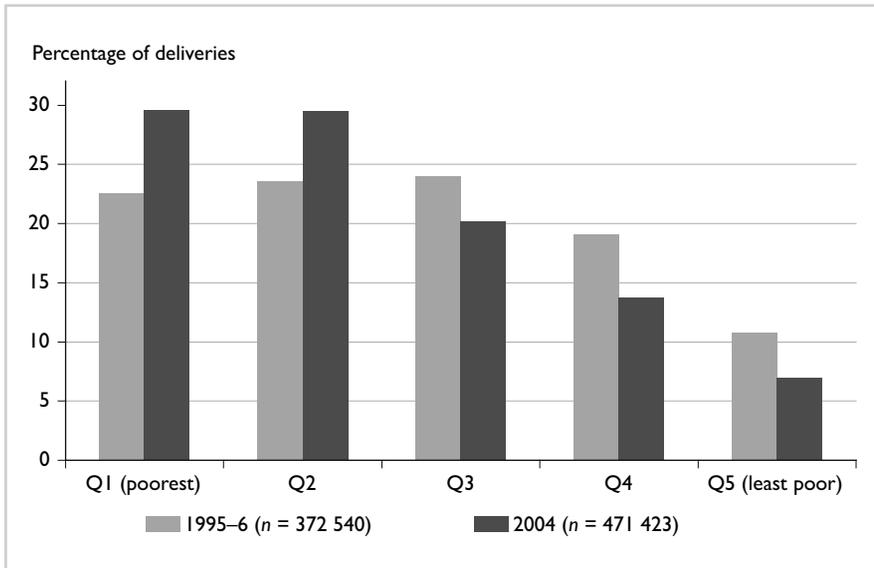
Source: Deputy Director, Health Services, Dharmapuri District, Tamil Nadu.

Figure 6.8 Average deliveries per month per primary health centre, Dharmapuri District, 2004–2009



Source: Deputy Director, Health Services, Dharmapuri District, Tamil Nadu.

Figure 6.9 Distribution of maternal deliveries in public facilities, Tamil Nadu, by socioeconomic quintile, 1995–1996 and 2004

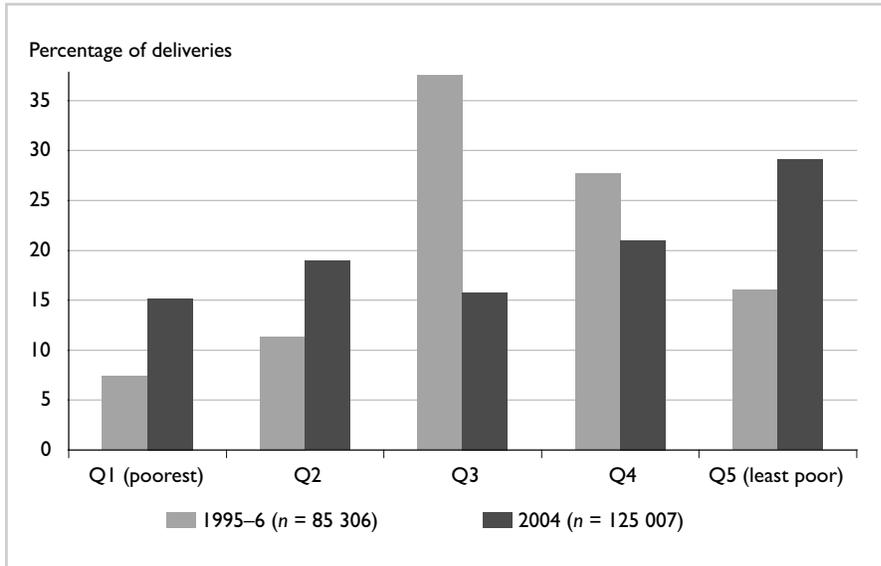


Source: Vaidyanathan G et al. (see text).

Evidence from a recent analysis on the use of public institutions for maternity and child health services shows that they are being used to a greater extent by those in poorer sections of the society (Vaidyanathan G et al. *Do the poor benefit from public spending on healthcare in India? Results from benefit (utilization) incidence analysis in Tamil Nadu and Orissa*. Unpublished draft report submitted to LSHTM, May 2010). This holds true for immunization (as discussed above) and other preventive health services that have a direct impact on maternal and child health³⁴. Figure 6.9 shows that, in terms of consumption, people in the poorest quintile have used the public delivery system for maternity services more than those in the top quintile. Such results are not obvious. For example, the public health care system for outpatient care and inpatient services was more pro-rich (that is, used by better-off groups) in 1995 than in later years. And in many poor states, such as Orissa (Figure 6.10), the public system continues to be pro-rich, meaning that those who are least poor are using services to a greater extent than the poorest, although programmatic interventions may be changing this situation (Vaidyanathan G et al., as above).

In summary, by 2005, public spending on health care in Tamil Nadu had become more pro-poor than it was a decade earlier. Although, as was noted in the Introduction, the private health sector also grew substantially over the same

Figure 6.10 Distribution of maternal deliveries in public facilities, Orissa, by socioeconomic quintile, 1995–1996 and 2004



Source: Vaidyanathan G et al. (see text).

period in rural as well as urban areas, the people interviewed by the research team reported that it was the deployment of village health nurses to rural villages and the state-wide network of primary health centres that led to the vast improvement in the overall access to care.

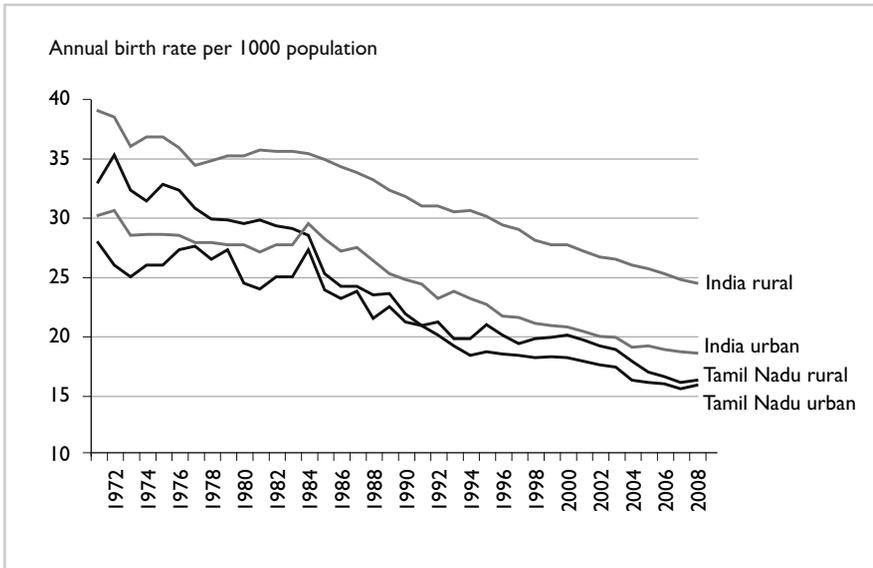
Much of these changes can be attributed to the efforts of village health nurses and the overall presence and functioning of the primary health delivery system in the state.

A former Joint Director, Salem District, Tamil Nadu

■ What have other sectors contributed?

What were the most significant factors outside the health system that contributed to improved health outcomes in Tamil Nadu between 1980 and 2005? A steady decline in the total birth rate (Figure 6.11) provided the initial conditions critical for effective health care interventions in later years. In addition, an increase in female literacy and progress on women's empowerment were also essential in reducing maternal and child morbidity and mortality. More broadly, extensive improvements in roads and in other infrastructure as well as industrial economic

Figure 6.11 Birth rate, India and Tamil Nadu (rural and urban) 1971–2008



Source: Adapted from reference 9.

growth also played important roles in Tamil Nadu's health gains over this period. Chapter 10 provides a more detailed analysis of how these and other cultural and socioeconomic factors affect the health status of populations.

Scholars have examined the fertility transition in south India during the 1970s and 1980s and have put forward several competing and complementary explanations on the reasons for the changes. These are still being debated today^{21,35}.

Literacy, age of first marriage and contraception use are three of the most widely accepted reasons for a declining fertility rate. Compared with India's average literacy rate in 2001 (75% for males and 54% for females), Tamil Nadu's rates of 82% for males and 65% for females indicate a fairly high level of literacy. The average age for females at marriage in Tamil Nadu is close to 20 years, older than in the rest of India; there is also a relatively high rate of contraception use, at about 50%.

The social reform movement in Tamil Nadu (particularly from the 1940s to the 1960s) also played an important role in raising the low status and limited autonomy of women in general. For example, as mentioned above, the state has the distinction of having the lowest gender differential in infant mortality and in

overall mortality figures. One of the most complex issues addressed in the academic literature relates to women's empowerment. Discussions are ensuing as to whether or not women in Tamil Nadu experience greater autonomy than those in other parts of the country, and whether or not such autonomy has had any effect on the fertility rate.

In one study, researchers examined dimensions of women's autonomy in Punjab in Pakistan, in Uttar Pradesh in north India and in Tamil Nadu in south India³⁶. They explored the contextual factors underlying observed differences and assessed the extent to which these differences could be attributed to religion, nationality or north-south cultural distinctions. Their findings suggest that while women's autonomy, in terms of decision-making, mobility, freedom from threatening relations with husband, and access to and control over economic resources, is constrained in all three settings, women in Tamil Nadu fare considerably better than women elsewhere in India, irrespective of religion. They argue that in the patriarchal and gender-stratified structures governing the northern portion of the subcontinent, women's control over their lives is more limited than in the southern region. There are, however, contrary views and some have suggested that observations of greater female autonomy in Tamil Nadu should be interpreted with circumspection^{37,38}.

The government's Family Welfare Programme has had a greater impact in this state than elsewhere in India. Mass media and the cinema have played a role promoting the benefits of a small family, which has contributed to changing cultural preferences and values.

In Tamil Nadu, a larger cross-section of people has access to maternal and child welfare services than in most other states in India. The Noon Meal Scheme, introduced to schoolchildren in the early 1980s, has been particularly successful.

Two other developments help to explain Tamil Nadu's low total fertility rate and better health outcomes compared with most other states in India: infrastructure development and industrialization.

Improvements in infrastructure and industrial economic growth not only directly affect production and consumption but also generate positive externalities, such as better health³⁹⁻⁴⁴. Since the early 1970s, compared with other developed states in India, Tamil Nadu has consistently performed better with respect to infrastructure development. A recent study shows that Tamil Nadu's Infrastructure Overhead Capital Index, which includes transportation facilities (roads and railways), irrigation, electricity and telephone mainline, ranked second in 1971/1972 and 1981/1982 among all major Indian states. It fell to fifth place in 1991/1992, but rose to third by the late 1990s⁴⁵.

A study based on demographic and health survey data for more than 60 low-income countries found that access to electricity significantly reduces child mortality, independent of any income effect⁴⁶. This is because electricity is not only essential for hospitals to function and for the delivery of health services but also for cooking at home with clean energy, which, in turn, improves health outcomes by reducing indoor air pollution and the incidence of respiratory illnesses.

Improved transportation networks contribute to easier access to health care, particularly in rural areas. A study using cross-section regressions found that road infrastructure (as measured by the length of the paved-road network) had a significant effect on a number of health indicators, including infant and maternal mortality rates⁴⁴.

Water and sanitation should be added to these factors because much of the morbidity and mortality among children results from waterborne infections (dysentery and diarrhoea are the major causes)¹⁹.

Four major features of industrialization in Tamil Nadu are noteworthy. First, Tamil Nadu is one of the leading states in India in industrial development. The state's share of the manufacturing sector in the national GDP has remained high at 14% in 1980/1981 and at about 17% in 2007/2008. Second, Tamil Nadu had the highest number of registered manufacturing factories (15–16%) for seven successive years, starting in 1997/1998. Third, Tamil Nadu ranks second behind Maharashtra in the percentage of people engaged in various activities of production. The state's share of the national total has consistently increased, from about 10% in early 1980s to about 14% during the period 2001–2005. Finally, Tamil Nadu is behind only Maharashtra and Gujarat in fixed capital, productive capital, gross value of output and net value added.

Economic development resulting from industrialization provides increased work opportunities and income growth and creates capital for public- and private-sector investment. These, in turn, improve material circumstances in the population and the ability to purchase goods and services that are health enhancing, particularly for child health⁴⁷.

It is important to highlight the contributions of nongovernmental organisations (NGOs) in the implementation of key national disease control programmes in Tamil Nadu. The state officials working on these programmes have consciously sought to engage NGOs in controlling the prevalence of HIV/AIDS and tuberculosis. The state, as many other states, has benefited from the creation of autonomous bodies such as Tamil Nadu State AIDS Control Society, with considerable financial support from external development partners since

mid-1990s. The Society's early disease control strategy was largely implemented through NGOs. More than 400 NGOs have received funds to implement health interventions over the last eight years (Ramasundaram S et al. *HIV/AIDS control in India: lessons from Tamil Nadu*. Unpublished research report draft submitted to ICRIER, New Delhi, 2001). It is important to emphasize the willingness of the public authorities in the state to collaborate with NGOs in addressing HIV/AIDS and tuberculosis. In the early 1990s, the state had the second highest prevalence of HIV in India. The rapid absorption of funds from the Government of India and other funding agencies through a network of NGOs has helped to control and reduce the prevalence of HIV, and this can be largely attributed to the public-private partnership model.

Several discussions with both district officials and NGOs point to the overall increase in income, along with higher literacy, a greater role of media and extensive improvement in public transportation facilities as factors that have made the public health system respond positively to the health care needs of the population.

■ **Lessons learned and future challenges**

Several lessons can be drawn from Tamil Nadu's experience over 25 years that may be helpful to other countries.

The focus in Tamil Nadu on primary health care ensured that a substantial share of the health budget was allocated to this level of care. The Ministry of Health established the physical infrastructure for effective primary care and set norms for public health facilities required to provide primary care to the local population. Field staff were recruited, with an emphasis on engagement of female health workers. Efforts were made to integrate complementary programmes at field level (including water, sanitation, nutrition and so forth).

The Government of Tamil Nadu developed and implemented an autonomous drug distribution system to ensure there was no delay in the purchase and movement of essential medicines for primary care. Other innovative delivery and financial management systems were adopted, such as 24-hour health facilities and the creation of autonomous bodies (quasi-governmental institutions) to bypass bureaucratic hurdles that would limit the effective delivery of essential care.

A number of other enabling conditions have contributed to Tamil Nadu's public health successes. These include political commitment at the highest level and support from the Government of India. At the same time, the state and district

administrations have been involved in the design and implementation of strategic policies and programmes. They have been active participants in large part because the Government of Tamil Nadu has worked to ensure that it has in place an adequate number of health personnel, from the field level up to district and state levels, who are trained and experienced in managing public health challenges. Recognition needs to be given to the work culture and commitment of field staff and all levels of management.

Outside of the health system, several cultural and socioeconomic factors have contributed to Tamil Nadu's achievements, such as a low fertility rate, better literacy, progress on women's empowerment and higher incomes.

Nevertheless, it should be noted that Tamil Nadu cannot claim to be in good health in all respects, and several pressing health challenges need to be tackled more effectively. Perhaps the greatest remaining challenge is addressing the alarmingly low nutritional status of adults and children, as in other states of India. High levels of malnutrition and undernutrition indicate that the state has had less success with policies aimed at tackling some of the broader determinants of health that fall outside the health sector. In fact, Tamil Nadu fares worse than many other states and the overall average in India with regard to average calorie and protein intake, and the number of babies who are underweight at birth.

In addition, more could be done to lower the maternal mortality rate. Nearly 60% of maternal deaths are from sepsis after delivery, postpartum haemorrhage, pulmonary embolism, anaemia and jaundice. A large number of maternal deaths continue to occur during transit (due to a lack of transportation, as in other parts of the country); at home, where 10% of women give birth; or even in maternity centres, due to the lack of skilled health personnel. All of these problems can be prevented through judicious policy interventions.

Likewise, Tamil Nadu's infant mortality rate, although low compared with other states, could be even lower. About 60% of infant deaths occur at the early neonatal and post-neonatal stages (as in other states of India) and most could be prevented. Official estimates for 2008 show birth asphyxia and low birth weight accounted for many infant deaths in the state. While the aggregate infant mortality rate has fallen over the years, the relative contributions of asphyxia and low birth weight continue to be high (28% and 40%, respectively, in 2008) and pose serious challenges to policy makers.

Apart from the conditions covered by the Millennium Development Goals, Tamil Nadu, like all other states in India, needs to face the increasing burden of noncommunicable diseases. The Government of Tamil Nadu should pay special

attention to providing basic care to people in underserved areas, namely in hilly and tribal regions, and to developing policies to bring about behavioural changes. The most worrisome issue is the increasing financial burden on the poor from illnesses that require long-term care. Another emerging trend is that, as a result of increased public awareness of health issues, people have become much more conscious of their health status than in the past. This has led to rising expectations and demands for public health services, such as care for diabetes, hypertension, cancer and mental health.

Under the National Rural Health Mission introduced in 2005, with substantial increases in the overall budgetary allocation from the Government of India and with considerable managerial autonomy delegated to executive staff and field functionaries, the state has decreased maternal mortality and infant mortality rates even further, and has also begun to meet the demand for services for noncommunicable diseases.

Efforts are being made to upgrade primary health centres with modern diagnostic facilities and, in particular, to provide them with the equipment and skilled health personnel needed to prevent neonatal, infant and maternal deaths. Like many other Indian states, Tamil Nadu has recently introduced a vast network of emergency services, which also provide emergency obstetric care. Consequently, the financial burden on the general population should decrease considerably, through reductions in out-of-pocket expenditure.

Meanwhile, DANIDA has been instrumental in establishing a health management information system, which will reduce the workload on village health nurses, on the staff at primary health centres and on first referral units for regular reporting of vital events and other information. The health management information system has already been extended to all districts. In time, it is expected to evolve into a better management decision support system.

Although Tamil Nadu still has a long way to go to address the above challenges effectively, the signs are positive that it is moving in the right direction. Its successes to date can provide useful lessons and a backdrop for the hurdles it has to face, both now and in the future.

ACKNOWLEDGEMENTS

We are extremely grateful to a large number of individuals who have contributed to this chapter. Several of them had served the Government of Tamil Nadu and Government of India during the 1980s and 1990s. Several others are still in service. Their frank and perceptive insight has helped us construct a credible

account of the health sector of Tamil Nadu over the past three decades. In particular, we are grateful to the Government of Tamil Nadu for sharing with us a large number of documents and statistics.

Our special thanks to Dr Dina Balabanova of the London School of Hygiene & Tropical Medicine and her entire research team for their constant intellectual support and patient response to every single difficulty we faced at various stages of this study. Our special thanks to Wendy Wisbaum for her excellent editorial help.

We are immensely grateful to the Rockefeller Foundation for providing us with the opportunity to share the experience of Tamil Nadu with the international community and for allowing us to be part of this comparative study.

REFERENCES

1. Ministry of Home Affairs. Directorate of Census Operations – Tamil Nadu. *Census-2011. Provisional Population Total*. Chennai: National Informatics Centre; 2011 (http://www.census.tn.nic.in/state_ppt.php, accessed 31 July 2011).
2. Government of India. *Census 2001* [database online] New Delhi: Office of the Registrar General & Census Commissioner, India; 2001 (http://www.censusindia.gov.in/Census_Data_2001/Census_data_finder/C_Series/Population_by_religious_communities.htm, accessed March 2011).
3. Government of India. *National Health Accounts 2004–05*. New Delhi: Ministry of Health and Family Welfare; 2009 (http://www.whoindia.org/LinkFiles/Health_Finance_National_Health_Accounts_2004-05.pdf, accessed June 2011).
4. Roa KD et al. *India's health workforce size, composition and distribution*. New Delhi: Public Health Foundation of India & World Bank; 2008 (HRH Technical Report 1).
5. International Institute of Population Sciences. *National Family Health Survey-III, 2005–06*. Mumbai: International Institute of Population Sciences; 2007.
6. Government of India. *Economic Survey of India 2010–11*. New Delhi: Government of India; 2010.
7. World Bank. Poverty Reduction & Economic Management Unit. South Asia Region. *Economic growth and poverty alleviation in Tamil Nadu. Notes on selected policy issues*. Washington, DC: World Bank; 2005.
8. Government of Tamil Nadu. *Tamil Nadu human development report 2003*. New Delhi: Social Science Press; 2003.

9. Registrar General of India. *Sample registration system*. New Delhi: Registrar General of India; 1970–2006.
10. Registrar General of India. *Sample registration system. Special bulletin on maternal mortality in India 2004–06*. New Delhi: Registrar General of India; 2009.
11. Government of India. *HIV sentinel surveillance and HIV estimation in India 2007. A Technical brief*. New Delhi: National AIDS Control Organisation, Ministry of Health & Family Welfare, Government of India; 2008.
12. Registrar General of India. *Sample Registration System*. New Delhi: Registrar General of India; 2007.
13. International Institute of Population Sciences. *National family health survey-II, 1998–99*. Mumbai: International Institute of Population Sciences; 2000.
14. Nandraj S et al., eds. *Private health sector in India: review and annotated bibliography*. Mumbai: Centre for Enquiry into Health and Allied Themes; 2001.
15. International Institute of Population Sciences. *National family health survey-I, 1992–93*. Mumbai: International Institute of Population Sciences; 1994.
16. Narayana D. Intensifying infant mortality inequality in India and a reversal by policy intervention. *Journal of Human Development and Capability* 2008; 9(2):265–81.
17. Athreya V, Chunkath SR. Gender and infant survival in rural Tamil Nadu: situation and strategy. *Economic and Political Weekly* 1998; 33(40):3–9.
18. Jejeebhoy SJ. Addressing women's reproductive health needs: priorities for the family welfare programme. *Economic and Political Weekly* 1997; 32(9/10):475–84.
19. Government of Tamil Nadu. *Annual policy notes*. Chennai: Department of Health and Family Welfare; 1985–2006.
20. Government of Tamil Nadu. *Annual State's Budget Estimates. Performance Budget*. Chennai: Health and Family Welfare Department, Chennai; 1996–2006.
21. Guilмото CZ, Rajan SI, eds. *Fertility transition in South India*. London: Sage; 2005.
22. Kaul M. The new public administration: management innovations in government. *Public Administration and Development* 1997; 17(1):13–26.
23. Bennett S, Muraleedharan VR. 'New public management' and health care in the third world. *Economic and Political Weekly* 2000; 35(1–2):59–68.
24. Das Gupta M et al. *How to improve public health systems: lessons from Tamil Nadu*. Washington, DC: World Bank, Development Research Group; 2009.

25. DANIDA. *Country Report India: evaluation of DANISH bilateral assistance to health 1988–97*. Copenhagen: Danish International Development Agency; 1999.
26. Government of Tamil Nadu. *Adoption of primary health centres/government hospitals*. Chennai: Health and Family Welfare Department; 1998 (Order no. 349, 22 June 1998).
27. Government of Tamil Nadu. *Government Order No. 449*. Chennai: Health and Family Welfare Department; 1998 (August 1998).
28. Pande RP, Yasbeck AS. What's in a country average? Wealth, gender and regional inequalities in immunization in India. *Social Science & Medicine* 2003; 57(11):2075–88.
29. Gaudin S, Yasbeck AS. Immunization in India 1993–1999: wealth, gender, and regional inequalities revisited. *Social Sciences & Medicine* 2006; 62(3):694–706.
30. Lalitha N. Tamil Nadu Government intervention and prices of medicine. *Economic and Political Weekly* 2008; 43(1):66–71.
31. Muraleedharan VR. Private–public sector partnership in health care sector in India: a review of policy options and challenges. In: Nandraj S et al., eds. *Private health sector in India: review and annotated bibliography*. Mumbai: Centre for Enquiry into Health and Allied Themes; 2001:29–49.
32. Padmanaban P, Raman PS, Mavalankar DV. Innovations and challenges in reducing maternal mortality in Tamil Nadu, India. *Journal of Health, Population, and Nutrition* 2009; 27(2):202–19.
33. WHO Regional Office for South East Region. *Safer pregnancy in Tamil Nadu: from vision to reality*. New Delhi: WHO Regional Office for South East Region; 2009.
34. Peters DH et al. *Better health systems for India's poor: findings, analysis and options*. Washington DC: World Bank; 2002.
35. Bhattacharya P. Economic development, gender inequality and demographic outcomes: evidence from India. *Population and Development Review* 2006; 32(20):263–91.
36. Jejeebhoy SJ, Sathar ZA. Women's autonomy in India and Pakistan: the influence of religion and region. *Population and Development Review* 2001; 27(4):687–712.
37. Sundari Ravindran TK. Female autonomy in Tamil Nadu: unravelling the complexities. *Economic and Political Weekly* 1999; 34(16/17):WS34–WS44.
38. Rahman L, Rao V. The determinants of gender equity in India: examining Dyson and Moore's thesis with new data. *Population and Development Review* 2004; 30(2):239–68.

39. Brennenman A, Kerf M. *Infrastructure and poverty linkages: a literature review*. Washington, DC: World Bank; 2002.
40. Behrman JR, Wolfe BL. How does mother's schooling affect family health, nutrition, medical care usage, and household sanitation? *Journal of Econometrics* 1987; 36(1-2):185-204.
41. Lavy V et al. Quality of health care, survival and health outcomes in Ghana. *Journal of Health Economics* 1996; 15(3):333-57.
42. Lee L, Rosenzweig MR, Pitt MM. The effects of improved nutrition, sanitation, and water quality on child health in high-mortality populations. *Journal of Econometrics* 1997; 77(1):209-35.
43. Leipziger D et al. *Achieving the Millennium Development Goals: The role of infrastructure*. Washington, DC: World Bank; 2003 (Working Paper No. 3163).
44. Wagstaff A, Claeson M. *The millennium development goals for health: rising to the challenges*. Washington, DC: World Bank; 2004.
45. Ghosh B, De P. Investigating the linkage between infrastructure and regional development in India: era of planning to globalisation. *Journal of Asian Economics* 2005; 15(6):1023-50.
46. Wang L. Determinants of child mortality in LDCs: empirical findings from demographic and health surveys. *Health Policy* 2003; 65(3):277-99.
47. Gwatkin DR. Poverty and inequality in health within developing countries: Filling the information gap. In: Leon DA, Walt G, eds. *Poverty, inequality and health: an international perspective*. Oxford: Oxford University Press; 2001:217-46.