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Determinants of cost of routine immunization programme in India

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ABSTRACT

The costs of delivering routine immunization services in India vary widely across facilities, districts and states. Understanding the factors influencing this cost variation could help predict future immunization costs and suggest approaches for improving the efficiency of service provision.

We examined determinants of facility cost for immunization services based on a nationally representative sample of sub-centres and primary health centres (99 and 89 facilities, respectively) by regressing logged total facility costs, both including and excluding vaccine cost, against several explanatory variables. We used a multi-level regression model to account for the multi-stage sampling design, including state- and district-level random effects.

We found that facility costs were significantly associated with total doses administered, type of facility, salary of the main vaccinator, number of immunization sessions, and the distance of the facility from the nearest cold chain point.

Use of pentavalent vaccine by the state was an important determinant of total facility cost including vaccine cost. India is introducing several new vaccines including some supported by Gavi. Therefore, the government will have to ensure that additional resources will be made available after the support from Gavi ceases.

1. Introduction

The costs of delivering routine immunization services vary widely across facilities within countries and across countries [1–4]. Understanding the reasons for such variation can provide insights into site operations and help improve programme efficiency. Recently, under the EPI Costing and Financing (EPIC) project, a few studies have investigated the cost drivers of routine immunization programmes [5,6]; however, there is clearly a dearth of such evidence in large countries like India. Because immunization programmes differ across countries based on distribution of health care services, population characteristics, and vaccine schedules, country-level information on costs and cost determinants is important.

India's national immunization programme was introduced in 1978 following the success of smallpox eradication [7]. The programme is the largest in the world and covers a birth cohort of 26 million infants for eight vaccine-preventable diseases: diphtheria, whooping cough, tetanus, poliomyelitis, tuberculosis, measles, hepatitis B, and *Haemophilus influenzae* type B (Hib) (which causes pneumonia and meningitis). The programme also provides vaccination for Japanese encephalitis in areas affected by the disease. Recently, a vaccine against rotavirus has been introduced in nine states, and pneumococcal vaccine has been introduced in a cohort of three states with a plan to rapidly scale up in other cohorts or states.

The total expenditure for India's immunization programme as reported in the comprehensive multi-year plan for immunization (cMYP), was US$718 million in 2012–13 [8], and a recent study on routine immunization costs showed substantial variation in unit costs across facilities, districts and states [9]. During 2013–14, the weighted average state-level cost per dose delivered varied from US$1.31 to US$2.79 including the vaccine cost, while the cost per child vaccinated with the third dose of diphtheria, pertussis, tetanus (DPT) vaccine (a proxy for full immunization) varied from US$19.11to US$33.13 including the vaccine cost. In this study, we examine the factors underlying these cost variations and suggest approaches to improving the efficiency of service provision.

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2. Methods

As part of the India immunization costing study, data on immunization service costs were collected from 255 government health facilities of different types across seven states, using a multi-stage cluster sampling design [9]. India's 29 states were stratified into six levels of development based on indicators such as female literacy rate, full immunization coverage rate, infant mortality rate, and per capita income. The states were further classified into six regions – north, northeast, east, central, south and west. To ensure a nationally representative sample, the study used stratified purposeful sampling to select seven states representing all six levels of development and all six regions. Study states included Punjab (north); Meghalaya (northeast); Bihar and West Bengal (east); Uttar Pradesh (central); Kerala (south); and Gujarat (west). Although Bihar and Uttar Pradesh were at the same level of development, both were selected as they have high priority for improving immunization coverage.

The costing study had calculated the number of health facilities that would be required to estimate the mean cost per fully vaccinated child within a margin of error of US$3 with a 95% confidence interval in each of the selected states, after accounting for the multi-stage cluster sampling design. In the calculation, the standard deviation of the cost per fully immunized child was assumed to be US$8 or US$10, depending on the state under consideration. The two-stage cluster sampling design was accounted for by multiplying the sample size obtained under simple random sampling by the design effect of 1.2.

Because of time and resource constraints, the researchers reduced the number of health facilities in Uttar Pradesh and Bihar. The study comprised 24 health facilities each from Uttar Pradesh and Bihar; 48 health facilities each from Gujarat, Punjab and West Bengal; 33 from Kerala; and 30 from Meghalaya, resulting in a total of 255 facilities across seven states [9]. To ensure representativeness at the state level, the study used a stratified sampling design to select health facilities in each state. Districts in the selected states were divided into three or four strata based on the scores obtained from four district-level indicators: number of children aged 0–6 years, proportion of households in rural areas, proportion of children aged 0–6 years receiving full immunization, and number of health facilities per 1000 children. One district from each stratum was randomly selected using a computer application that employs random number generator. In each district, two blocks (sub-districts) were selected using purposive sampling based on two indicators: (1) the percentage of scheduled caste or scheduled tribe members in the population; and (2) the female literacy rate. The blocks were selected to cover the lower and upper extremes of these indicators. Each block typically has one community health centre (CHC),[2] which was selected for inclusion in this study. In addition, two or three primary health centres (PHCs) associated with the CHC, as well as one or two sub-centres (SCs) under the selected PHCs were randomly selected. The final sample comprised 255 health facilities of four different types: 44 CHCs, 89 PHCs, 99 SCs, and 23 post-partum (PP) units at the district hospitals of the selected districts. A flow chart (Fig. 1) summarizes the sampling strategy followed within a selected state.

Economic costs of routine immunization were estimated from a government provider perspective and based on an approach that adapted a standardized method used for immunization costing studies (Common Approach) [11]. Total facility cost was the sum of personnel, capital costs, and all other recurrent expenses. Personnel costs were estimated based on salaries and allowances for various categories of staff involved in immunization and the time staff spent on activities related to immunization, which included conducting immunization sessions, transporting vaccines, keeping records, maintaining cold chains, monitoring and supervision, preparing microplans, and attending trainings and meetings. Capital costs included the annualized discounted value of cold chain equipment, vehicles and buildings. Costs for shared vehicles were based on the number of days a vehicle was used for immunization activities, while building costs were derived from the number of days a building was used for immunizations and the proportion of the building used. Other recurrent expenses were costs of vaccines and supplies, expenditures on trainings, meetings, vaccine transport, waste management, cold chain maintenance, printing, traveling to immunization sessions, and incentives, along with overhead expenses (e.g., for electricity and water). Overhead expenses were distributed to immunization and cold chain rooms based on share of space used for immunization.

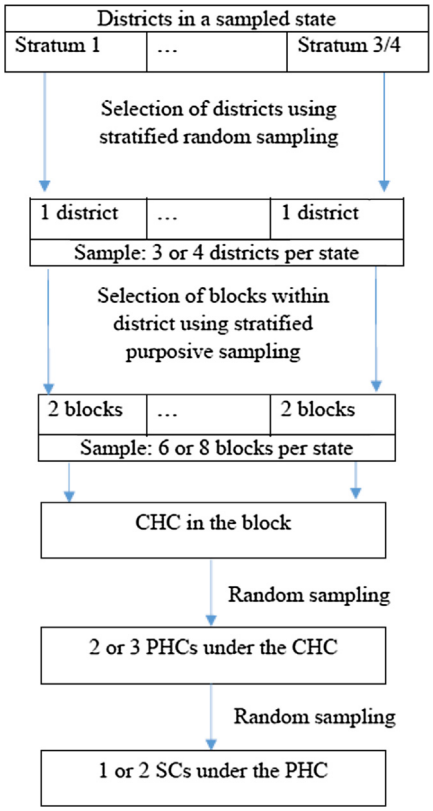

Fig. 1. Flow chart describing sampling strategy within a selected state: same flow chart is applicable for all seven states. *Note:* CHC: community health centre; PHC: primary health centre; SC: sub-centre.

Trained data collection teams visited each facility from October 2014 to October 2015. Data were gathered from financial reports, monthly immunization reports, immunization registers showing the total vaccines administered, and vaccine stock and issue registers. To determine person-time spent on immunization activities, the team interviewed staff involved in these activities. Data were also collected on possible determinants of immunization costs, including number of sessions and distance from the nearest cold chain point. Wastage rates for each vaccine at the vaccinator level were calculated using doses used and doses administered [9]. Total costs were estimated for one fiscal year, April 2013 to March 2014, and results were reported in 2013 US dollars. Throughout the

[2] In India's rural health system, SCs are the most peripheral and the first contact point between the primary health care system and the community. Each PHC is a four- to six-bed referral unit for six SCs. CHC is a 30-bed hospital or referral unit of four PHCs with specialized services [10]. In each district, there is generally one district hospital; immunization activities are conducted in each district hospital's post-partum unit.