Research And Development Solutions

Efficiency of Immunization Services and Impact of COVID-19: A Data Envelopment Analysis (DEA) of Child Immunization Facilities in Pakistan

Introduction

Pakistan's Expanded Program on Immunization (EPI) provides vaccines against childhood diseases such as pertussis, tuberculosis, poliomyelitis, tetanus, diphtheria, and measles for children aged 12-23 months. The EPI costs USD 417 million annually (2016-2020)[1] of which 84% is contributed by the (national or provincial) Government of Pakistan. These funds yield full immunization coverage for 54% children, with 1.4 million children remaining under and un-vaccinated.[2]

While one solution to improve immunization coverage may be to increase the funding of immunization activities, such increases may be limited by fiscal and political challenges. We offer an option to optimize the use available resources. This methodology can be applied at national, provincial, district or even facility level, and can be done with the data currently available through the vaccine logistics management information system (vLMIS).
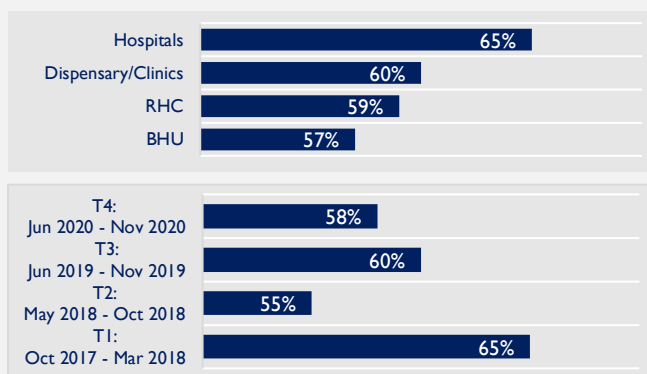
Methodology

Data were obtained for 136 EPI facilities from the Cold Chain Equipment Optimization Platform (CCEOP) project, sponsored by GAVI. There are four types of facilities in the data: Basic Health Units, Rural Health Clinics, Dispensaries/Clinics and Hospitals. Data collection consisted of 4 time periods, starting from May 2018 and ending at December 2020. A two-stage approach called **Data Envelopment Analysis (DEA)** was adopted to approximate the efficiency of immunization facilities, using outputs (doses administered) and inputs (stock available, staff, cold chain equipment, vaccine carriers and vaccine sessions) and the influence of external variables including COVID-19 which fell under the last time period on efficiency.

Findings

Our model suggests that facilities are on average operating at only 59% efficiency. This means that, in comparison to the most efficient facilities in the sample, most facilities could accomplish greater vaccination coverage with less resources.

Figure 1: Average Efficiency Score by Facility Type and Time Period

Facility Type	Efficiency
Hospitals	65%
Dispensary/Clinics	60%
RHC	59%
BHU	57%

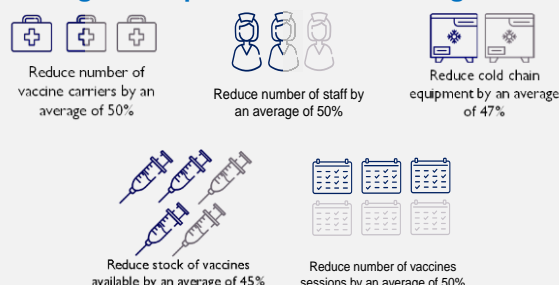| Time Period	Efficiency
T4: Jun 2020 - Nov 2020	58%
T3: Jun 2019 - Nov 2019	60%
T2: May 2018 - Oct 2018	55%
T1: Oct 2017 - Mar 2018	65%

Salient Findings

- Hospitals are the most efficient facility type
- On average facilities have 48% more inputs than needed
- DEA can be automated through algorithms and applied at federal, provincial, district or facility levels

Hospitals are the most efficient facility type with 65% efficiency, while Basic Health Units are the least efficient. Facilities were operating most efficiently in first time period and least efficiently in the second time period.

The last time period, which falls under COVID-19, the efficiency was 58% which is lower than sample average (59%). It indicates that due to COVID-19 restriction average efficiency of immunization facilities had dropped as people were delaying their children vaccination schedule due to fear of COVID-19 infections.

In addition to determining efficiency scores, the model also calculates the optimal level of inputs that can maximize the outputs. These calculated reductions in inputs are shown below in comparison to the current input usage by the facilities.

Figure 2: Input Reduction Percentages

Reduce number of vaccine carriers by an average of 50%

Reduce number of staff by an average of 50%

Reduce cold chain equipment by an average of 47%

Reduce stock of vaccines available by an average of 45%

Reduce number of vaccines sessions by an average of 50%

On average each facility needs to reduce their inputs by 48% in order to enhance their efficiency given their vaccination administered. Given the outreach program is exhausted then it implies that the allocation of resources is not properly aligned with the catchment population.

Way Forward

- An efficiency analysis is a simplified tool to maximize the use of limited resources that can be applied at federal, provincial, district or facility level

- This methodology may be automated through algorithms that can work with existing datasets such as the vLMIS and would not require inputs from statisticians

[1] Country Multi Year Plan (cMYP) 2016-20
[2] Pakistan Demographic and Health Survey 2017-18

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