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Child Immunisation in Madhya Pradesh

Evidence from Mother and Child Tracking System

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Background

The Mother and Child Tracking System (MCTS) was launched by the Government of India in December 2009. As the name implies, MCTS is a tracking system which aims at improving the performance of maternal and child health services by tracking each and every woman and child registered in the system in terms of the services received. The data available through MCTS allows assessment of the performance of maternal and child health services in terms of delivering a specified set of services to women and children according to the pre-defined schedule.

Performance of any services delivery system may be measured in terms of the realised efficiency of the system in delivering a specified set of services to the target beneficiaries. If the services delivery system is able to deliver the specified set of services to all the target beneficiaries according to the pre-defined schedule, its realised efficiency is 100 per cent and vice versa. Obviously, the higher is the realised efficiency, the better is the performance of the services delivery system.

The realised efficiency of any services delivery system comprises of two components - needs effectiveness and capacity efficiency. Needs effectiveness measures the ability of the services delivery system to reach those who are in need of services. The capacity efficiency, on the other hand, is related to delivering 'full' range of services to those who are within the reach of the system. The realised efficiency or the performance of the services delivery system is the product of the needs effectiveness and the capacity efficiency of the system. As such, improvements in both needs effectiveness and capacity efficiency are necessary to improve the realised efficiency and hence the performance of the services delivery system.

In this paper, we use the data available through MCTS to measure the performance of child immunisation services in Madhya Pradesh and for its constituent districts by estimating the realised efficiency of the health system in delivering immunisation services. We also estimate the needs effectiveness and capacity efficiency of immunisation services to analyse how the realised efficiency of the health system in delivering child immunisation services is influenced by the effectiveness of the system in reaching all live births - the needs effectiveness - and its capacity in terms of fully immunising those live births who are registered in MCTS or, in other words, are within the reach of the health system - the capacity efficiency. The analysis suggests that the realised efficiency of child immunisation services in the state and in its constituent districts is far from satisfactory and there is sufficient scope for improving both needs effectiveness of the system in capturing all live births in MCTS as well as in completely immunising according to the immunisation schedule those live births who have been registered in MCTS. Variation in both needs effectiveness and capacity efficiency of child immunisation services across the districts of the state indicate that there is no universal prescription to improve needs effectiveness and capacity efficiency and hence realised efficiency or performance of child immunisation services in the state.

Methodology

The methodology of the present analysis comprises of following a cohort of live births in terms of different vaccines received. The reference point for the present analysis is January 2014. MCTS provides district wise number of children who were born in the month of January 2014. According to the immunisation schedule, all children born in the month of January 2014 should have been "fully" immunised by December 2015. Thus the proportion of children born in the month of January 2014 who were fully immunised by December 2014 reflects the realised efficiency of the immunisation services. Thus the realised efficiency (RE) of immunisation services in the present analysis defined as

$$RE = \frac{\text{Number of children born in January 2014 who are fully immunised}}{\text{Number of children born in January 2014}}$$

On the other had, needs effectiveness (NE) and capacity efficiency (CE) of immunisation services are defined as

$$NE = \frac{\text{Number of children born in January 2014 registered in MCTS}}{\text{Number of children born in January 2014}}$$

$$CE = \frac{\text{Number of children born in January 2014 who are fully immunised}}{\text{Number of children born in January 2014 registered in MCTS}}$$

Obviously,

$$RE = NE * CE.$$

Measurement of the realised efficiency of immunisation services, especially, measurement of the needs effectiveness, requires estimates of the total number of live birth during the period under reference - January 2014 in the present analysis. We have used an indirect approach to estimate the number of children born during the month of January 2014. First, child-women ratio was estimated for each state and Union Territory of the country on the basis of the age and sex data available through the 2011 population census. Next, state/Union Territory level estimates of birth rate available through the Sample Registration System were regressed on the child-woman ratio. The regression analysis revealed that the birth rate was almost linearly related to the child-woman ratio with a coefficient of determination of almost 75 per cent. We assumed that the resulting regression equation described the underlying relationship between the birth rate and the child-woman ratio in any population. Finally, the child-woman ratio for the districts of the state was estimated from the 2011 population census data and using this ratio, birth rate was estimated for each of the 50 districts of the state. These estimates of the birth rate were then used to estimate the number of live births during January 2014.

Realised Efficiency

Our estimates suggest that total number of live births in Madhya Pradesh in the month of January 2014 was 164.7 thousand in Madhya Pradesh. Against these estimated live births, the number of children who received all the primary vaccination by 1 February 2015 was 74.98 thousand. This means that the realised efficiency of immunisation services in Madhya Pradesh was around 45.6 per cent during the year 2014. Ideally, the realised efficiency of immunisation services should be 100 per cent which means that all live born should have received all primary vaccinations.

The efficiency of immunisation services has been found to vary widely across the districts of the state according to the information available through MCTS. Table 1 presents the distribution of districts according to the level of the realised efficiency of immunisation services. The realised efficiency of immunisation services has been estimated to be very poor in six districts of the state. In district Singrauli, only about 17 per cent of the children born during January 2014 received complete vaccination by 1st February 2015. This proportion is the lowest among all districts of the state. On the other hand, in district Indore, almost 70 per cent of the estimated children born during January 2014 received complete vaccination and this proportion was the highest in the state. The realised efficiency has been estimated to be poor (30-50 per cent) in 27 districts; and average (50-70 per cent) in 17 districts. There is no district in the state where the realised efficiency of immunisation services has been found to be good (70-90 per cent) or very good (90 per cent and more) according to MCTS.

As already discussed, realised efficiency depends on both needs effectiveness and capacity efficiency. Improving realised efficiency, therefore, requires improving both needs effectiveness and capacity efficiency of immunisation services.

Needs Effectiveness

The needs effectiveness of immunisation services in the state as a whole is estimated to be around 80 per cent which means that approximately 20 per cent of the estimated children born in January 2014 could not be registered in MCTS. In district Singrauli, this proportion is around 42 per cent which means that only about 58 per cent of the estimated number of children born in January 2014 in the district could be registered in MCTS and this proportion is the lowest in of the state. By contrast, in district Ratlam, almost 99 per cent of the estimated children born in January 2014 have been found to be registered in MCTS, and this proportion is the highest in the state. In addition to district Singrauli, district Alirajpur is the only other district in the state where more than 40 per cent of the estimated number of children born during January 2014 could not be registered in MCTS. On the other hand, in 10 districts, more than 90 per cent of these have been found to be registered in MCTS.

Figure 1
Realised efficiency of immunisation services in districts of Madhya Pradesh

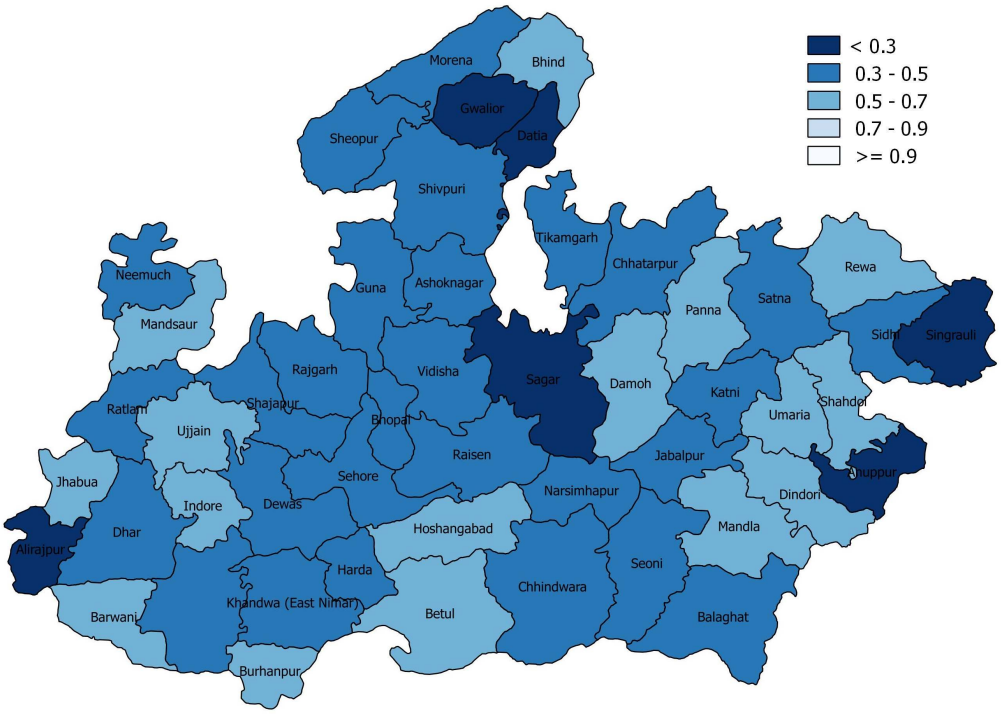


Table 1
Realised efficiency of immunisation services in Madhya Pradesh

Realised efficiency	Districts	
	Number	Name
< 0.30	6	Singrauli, Alirajpur, Gwalior, Datia, Sagar, Anuppur
0.30-0.50	27	Sheopur, Sehore, Seoni, Vidisha, Rajgarh, Sidhi, Chhindwara, Shivpuri, Neemuch, Bhopal, Guna, Tikamgarh, Harda, Satna, Katni, Raisen, Dewas. Morena, Ratlam, Shajapur, Ashoknagar, East Nimar, Jabalpur, Balaghat, Dhar, Narsimhapur, Chhatarpur
0.50-0.70	17	West Nimar, Hoshangabad, Mandla, Rewa, Bhind, Barwani, Umaria, Panna, Betul, Dindori, Shahdol, Ujjain, Burhanpur, Mandsaur, Jhabua, Damoh, Indore

Figure 2
Needs effectiveness of immunisation services in districts of Madhya Pradesh

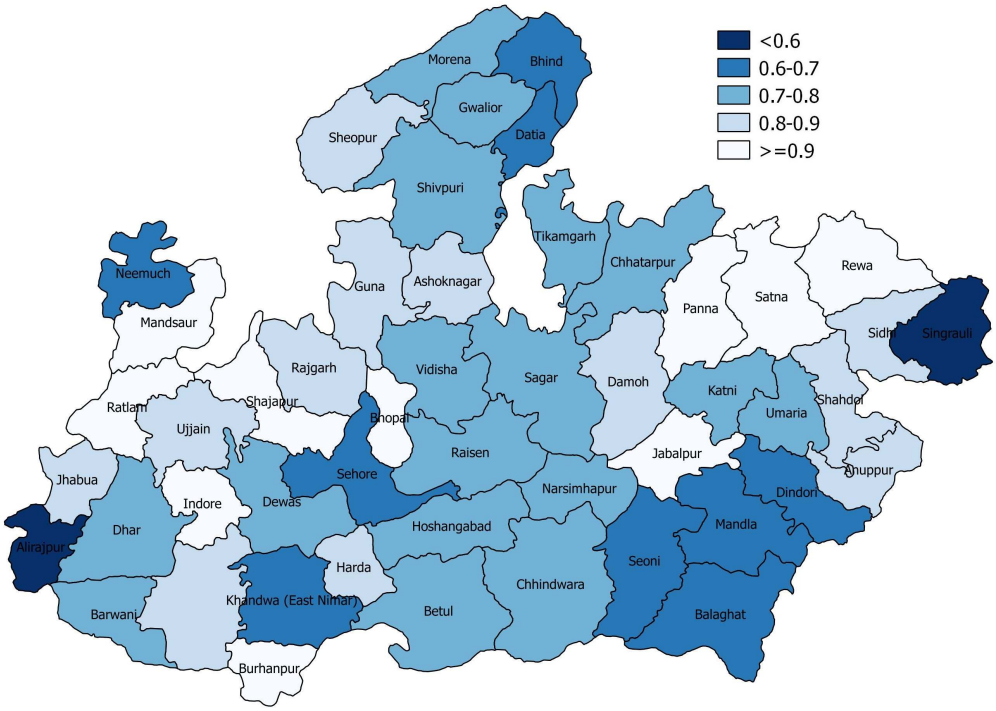


Table 2
Needs effectiveness of immunisation services

Realised efficiency	Districts	
	Number	Name
Less than 0.60	2	Singrauli, Alirajpur
0.60-0.70	8	Neemuch, Seoni, Bhind, Datia, Balaghat, East Nimar, Mandla, Sehore
0.70-0.80	18	Dindori, Tikamgarh, Dewas, Raisen, Sagar, Barwani, Chhindwara, Umaria, Betul, , Hoshangabad, Vidisha, Katni, Morena, Shivpuri, Dhar, Narsimhapur, Gwalior, Chhatarpur
0.80-0.90	12	Sheopur, Sidhi, Shahdol, Jhabua, West Nimar, Ujjain, Anuppur, Ashoknagar, Guna, Rajgarh, Damoh, Harda
0.90 and above	10	Mandsaur, Indore, Satna, Jabalpur, Shajapur, Bhopal, Rewa, Burhanpur, Panna, Ratlam

Figure 3
Capacity efficiency of immunisation services in districts of Madhya Pradesh

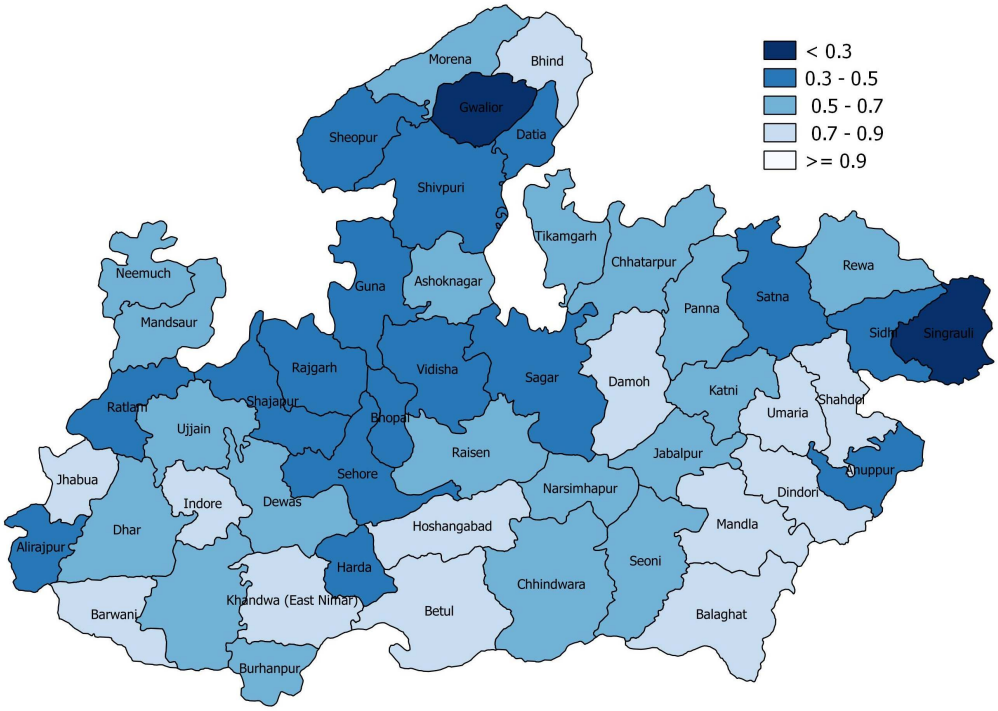


Table 3
Capacity efficiency of immunisation services in Madhya Pradesh

Realised efficiency	Districts	
	Number	Name
Less than 0.30	2	Singrauli, Gwalior
0.30-0.50	16	Anuppur, Sagar, Alirajpur, Bhopal, Datia, Sheopur, Rajgarh, Guna, Ratlam, Satna, Sidhi, Harda, Shajapur, Shivpuri, Vidisha, Sehore,
0.50-0.70	19	Jabalpur, Ashoknagar, Rewa, Seoni, Katni, Panna, Tikamgarh, Morena, Raisen, West Nimar, Dewas. Dhar, Neemuch, Chhatarpur, Narsimhapur, Burhanpur, Mandsaur, Ujjain
0.70-0.90	13	East Nimar, Hoshangabad, Balaghat, Shahdol, Indore, Damoh, Umaria, Barwani, Betul, Mandla, Bhind, Jhabua, Dindori

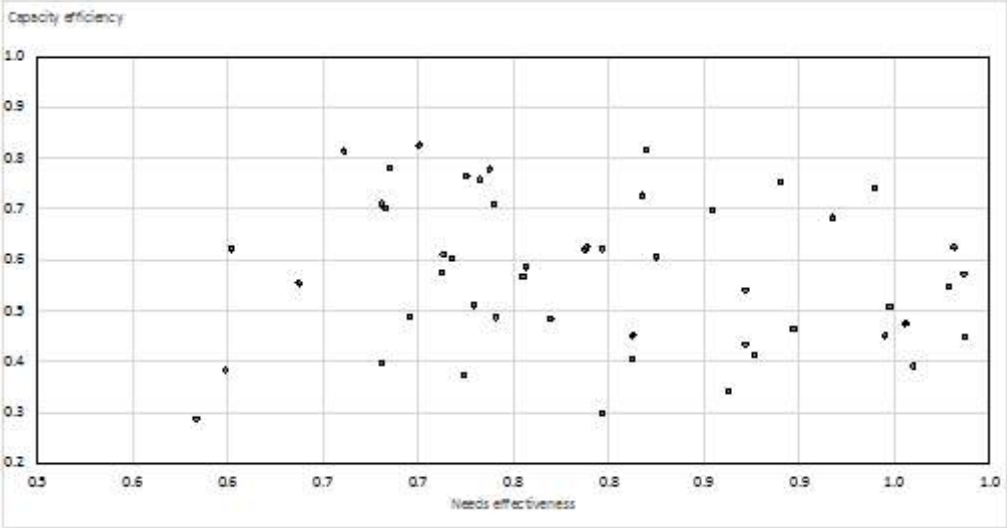
In the context of improving the performance or the realised efficiency of immunisation services, it is imperative that the needs effectiveness must be cent per cent. This means that all live births taking place in the state or in constituent districts of the state must be registered in MCTS so that all live births can be tracked for the delivery of immunisation services and full immunisation of all new born according to the immunisation schedule could be ensured. The seriousness of the issue of registering all live births in MCTS may be judged from the observation that in two third districts of the state, less than 50 per cent of the estimated number of children born in the month of January 2014 have been found to be registered in MCTS. Obviously, the first step towards improving the realised efficiency of immunisation services is to ensure cent per cent registration of live births in MCTS.

Capacity Efficiency

The capacity of the health system in fully immunising those children who are registered in MCTS is another dimension of improving the realised efficiency or the performance of immunisation services. In Madhya Pradesh around 57 per cent of children born in January 2014 and registered in MCTS have been found to be fully immunised in February 2015 according to MCTS which implies that the capacity efficiency of the immunisation services in the state can at best be termed as poor. In Singrauli and Gwalior districts of the state, less than 30 per cent of the January 2014 born children who were registered in MCTS have been found to be fully immunised with district Singrauli having the lowest proportion of January 2014 born children registered in MCTS to be full immunised. On the other hand, there are three districts - Bhind, Jhabua and Dindori - where more than 80 per cent of January 2014 born and registered in MCTS children have been found to be fully immunised. In 16 districts of the state, the capacity efficiency of the health system in terms of fully immunising those children who are registered in MCTS may be termed as poor as only around 30-50 per cent of January 2014 born children registered in MCTS have been found to be fully immunised. In 19 districts, on the other hand, the capacity efficiency of immunisation services may be termed as average as the proportion of January 2014 born registered in MCTS children who have been found to be fully immunised ranges between 50-70 per cent. This means that there are only 13 districts in the state where the capacity efficiency of immunisation services may be termed as satisfactory. In these districts, 70-80 per cent of the January 2014 born registered in MCTS children have been found to be fully immunised.

It is obvious that even if the health system becomes cent per cent needs effective in the sense that all live births are registered in MCTS, the realised efficiency of immunisation services will remain less than the cherished level of 100 per cent simply because the system does not have the necessary capacity to fully immunised even those children who have been registered in the MCTS. Improving the capacity efficiency is therefore also necessary to improve the realised efficiency.

Figure 1
Needs effectiveness and capacity efficiency of immunisation services



Interestingly, there is little association between the needs effectiveness and capacity efficiency of immunisation services across the districts of the state as figure 1 shows. This means that factors that influence the needs effectiveness of immunisation services and factors that effect the capacity efficiency are essentially different. This also means that improving the needs effectiveness will not lead to improvement in the capacity efficiency of immunisation services. In other words, in order to improve the realised efficiency of the performance of immunisation services, it is imperative that all registration of live births in MCTS is improved along with making sure that all children registered in MCTS are fully immunised. A two-pronged approach is therefore required to improve the realised efficiency and hence performance of immunisation services in the state.

Conclusions

The data available through MCTS suggests that there is substantial scope for improvement in the performance of immunisation services in the state. It is also clear from the analysis that improvements in both needs effectiveness and capacity efficiency is required to improve the realised efficiency and hence the performance of immunisation services. The analysis also suggests that needs effectiveness and capacity efficiency and hence the realised efficiency vary widely across the districts which means that a district-based approach is required to improve the performance of immunisation services. Although, the present analysis does not elaborate the reasons for the prevailing levels of needs effectiveness and capacity efficiency, yet it is very much obvious from the analysis that MCTS can be a very useful tool to improve the realised efficiency and hence the performance of immunisation services in the state.

Table 4
Estimates of realised efficiency, needs effectiveness and capacity efficiency of immunisation services in Madhya Pradesh

State / District	Needs effectiveness	Rank	Capacity efficiency	Rank	Realised efficiency	Rank
Madhya Pradesh	0.803		0.567		0.456	
Alirajpur	0.598	49	0.384	46	0.230	49
Anuppur	0.862	16	0.343	48	0.295	45
Ashoknagar	0.872	15	0.540	30	0.471	24
Balaghat	0.681	44	0.712	11	0.485	21
Barwani	0.725	35	0.765	6	0.555	12
Betul	0.737	32	0.779	5	0.574	9
Bhind	0.661	46	0.815	3	0.539	13
Bhopal	0.960	5	0.391	45	0.375	35
Burhanpur	0.981	3	0.626	16	0.615	5
Chhatarpur	0.796	23	0.623	18	0.496	18
Chhindwara	0.728	34	0.511	31	0.372	38
Damoh	0.890	12	0.753	8	0.670	2
Datia	0.681	45	0.396	44	0.270	47
Dewas	0.713	38	0.612	21	0.436	28
Dhar	0.788	26	0.622	20	0.490	20
Dindori	0.700	40	0.826	1	0.578	8
East Nimar	0.682	43	0.704	13	0.481	23
Guna	0.872	14	0.433	41	0.378	34
Gwalior	0.796	24	0.298	49	0.237	48
Harda	0.897	11	0.464	37	0.416	32
Hoshangabad	0.740	31	0.709	12	0.524	16
Indore	0.939	9	0.742	9	0.697	1
Jabalpur	0.947	7	0.508	32	0.481	22
Jhabua	0.820	19	0.816	2	0.669	3
Katni	0.755	29	0.568	27	0.429	30
Mandla	0.685	42	0.781	4	0.535	15
Mandsaur	0.917	10	0.685	15	0.628	4
Morena	0.756	28	0.585	24	0.442	27
Narsimhapur	0.788	25	0.626	17	0.493	19
Neemuch	0.602	48	0.622	19	0.374	36
Panna	0.986	2	0.573	26	0.565	10
Raisen	0.718	37	0.605	23	0.434	29
Rajgarh	0.876	13	0.413	42	0.361	40
Ratlam	0.987	1	0.450	40	0.444	26
Rewa	0.979	4	0.548	29	0.537	14

State / District	Needs effectiveness	Rank	Capacity efficiency	Rank	Realised efficiency	Rank
Sagar	0.724	36	0.373	47	0.270	46
Satna	0.945	8	0.451	39	0.426	31
Sehore	0.696	41	0.489	33	0.340	43
Seoni	0.637	47	0.554	28	0.353	42
Shahdol	0.817	20	0.727	10	0.594	7
Shajapur	0.956	6	0.475	36	0.454	25
Sheopur	0.812	22	0.407	43	0.330	44
Shivpuri	0.770	27	0.485	35	0.373	37
Sidhi	0.812	21	0.451	38	0.367	39
Singrauli	0.583	50	0.288	50	0.168	50
Tikamgarh	0.712	39	0.577	25	0.411	33
Ujjain	0.854	17	0.696	14	0.594	6
Umaria	0.732	33	0.761	7	0.557	11
Vidisha	0.741	30	0.486	34	0.360	41
West Nimar	0.824	18	0.607	22	0.500	17

Table 5
Capacity efficiency of different vaccines in districts of Madhya Pradesh

District	Vaccine				
	DPT	OPV	HEP	MEA	BCG
Alirajpur	0.3187	0.3187	0.3159	0.2437	0.5176
Anuppur	0.5670	0.5670	0.5670	0.3041	0.7528
Ashoknagar	0.6053	0.6049	0.6044	0.4826	0.8383
Balaghat	0.5863	0.5852	0.5846	0.4922	0.6556
Barwani	0.6364	0.6364	0.6350	0.5667	0.7132
Betul	0.6543	0.6543	0.6529	0.5830	0.7249
Bhind	0.6022	0.6019	0.6022	0.5494	0.6443
Bhopal	0.5501	0.5499	0.5486	0.3888	0.9252
Burhanpur	0.7001	0.7001	0.6996	0.6347	0.9377
Chhatarpur	0.5970	0.5944	0.5955	0.5080	0.7604
Chhindwara	0.5184	0.5169	0.5158	0.3773	0.7004
Damoh	0.7886	0.7883	0.7876	0.6837	0.8932
Datia	0.4311	0.4300	0.4300	0.2819	0.6105
Dewas	0.5396	0.5358	0.5370	0.4493	0.6709
Dhar	0.6325	0.6313	0.6276	0.5062	0.7349
Dindori	0.6179	0.6179	0.6166	0.5879	0.6734
East Nimar	0.5936	0.5933	0.5936	0.4830	0.6449
Guna	0.5439	0.5439	0.5436	0.3992	0.8671
Gwalior	0.4951	0.4932	0.4929	0.2490	0.7355
Harda	0.4939	0.4939	0.4939	0.4339	0.8487
Hoshangabad	0.6567	0.6551	0.6555	0.5302	0.7449
Indore	0.7900	0.7881	0.7859	0.7202	0.9070
Jabalpur	0.6101	0.6096	0.6081	0.4875	0.8922
Jhabua	0.7412	0.7403	0.7401	0.7022	0.8590
Katni	0.5906	0.5903	0.5892	0.4451	0.7037
Mandla	0.5793	0.5774	0.5783	0.5433	0.6397
Mandsaur	0.7365	0.7365	0.7365	0.6318	0.8919
Morena	0.5835	0.5833	0.5831	0.4517	0.7382
Narsimhapur	0.6010	0.6005	0.6005	0.5025	0.7358
Neemuch	0.4846	0.4886	0.4846	0.3784	0.6034
Panna	0.7554	0.7550	0.7550	0.5703	0.8837
Raisen	0.5536	0.5536	0.5533	0.4442	0.6840
Rajgarh	0.5674	0.5654	0.5651	0.3732	0.8294
Ratlam	0.5732	0.5722	0.5703	0.4590	0.9302
Rewa	0.6965	0.6920	0.6952	0.5454	0.9378
Sagar	0.3932	0.3895	0.3884	0.2928	0.6183
Satna	0.5972	0.5946	0.5956	0.4373	0.9151

District	Vaccine				
	DPT	OPV	HEP	MEA	BCG
Sehore	0.4563	0.4563	0.4559	0.3525	0.6006
Seoni	0.4624	0.4624	0.4620	0.3685	0.6102
Shahdol	0.7151	0.7151	0.7151	0.5944	0.8017
Shajapur	0.6698	0.6411	0.6689	0.4735	0.9319
Sheopur	0.5265	0.5243	0.5276	0.3611	0.7449
Shivpuri	0.4812	0.4810	0.4799	0.3775	0.6330
Sidhi	0.4371	0.4319	0.4332	0.3796	0.6041
Singrauli	0.2524	0.2515	0.2491	0.1728	0.4000
Tikamgarh	0.5173	0.5153	0.5099	0.4466	0.6467
Ujjain	0.7115	0.7102	0.7102	0.5985	0.8409
Umaria	0.5890	0.5883	0.5883	0.6110	0.7202
Vidisha	0.4845	0.4826	0.4803	0.3728	0.6741
West Nimar	0.6020	0.5985	0.5963	0.5115	0.7716