

Rationalization of IMR Targets for MDG-4

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Abstract

Millennium Development Goal 4 (MDG4) relating to Child Health aims at reducing Child Mortality Rate (U5MR) by one third between 1990 and 2015. This target was fixed by UN at the dawn of the century where 10 critical years out of the period of 25 years have already elapsed.

For monitoring the trend in U5MR, the other indicator linked was Infant Mortality Rate (IMR) which was implicitly assumed to decline by the same magnitude during the period of 25 years. Importantly, the U5MR comprise of two components; IMR and Mortality Rate of Children 1 to 5 years. Globally, the trend in decline for IMR has been slower as compared to decline in mortality rate for children 1 to 5 years. In view of this, IMR cannot be expected to decline in the same magnitude as U5MR. Hence the target for IMR is required to be rationalized, so that there is synchronization of achievements for U5MR and IMR. The rationalized target for IMR works out at 34 per 1000 live births as against 28 implicitly assumed. India though missing the target by 2015 is poised to achieve the target of U5MR under MDG-4 well ahead of global achievement.

Keywords: Exponential Trend, Under Five Mortality Rate, Infant Mortality Rate, Linear Trend, Millennium Development Goals.

1. Background

At the dawn of the new Millennium, in the Meeting at the United Nations it was decided to launch a concerted attack on poverty and the problems of illiteracy, hunger, poor health, discrimination against women, unsafe drinking water and a degraded environment. Accordingly Millennium Development Goals (MDGs) were fixed. Developing countries took the lead, especially regarding the first seven Goals concerning direct improvements in human well-being. These seven MDGs were:

- MDG - 1 Eradicate extreme poverty and hunger;
- MDG - 2 Achieve universal basic education;
- MDG - 3 Promote gender equality and empower women;
- MDG - 4 Reduce child mortality;
- MDG - 5 Improve maternal health;
- MDG - 6 Combat HIV/AIDS, malaria, and other diseases;
- MDG - 7 Ensure environmental sustainability

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These Millennium Development Goals (MDGs) are benchmarked for the 25 year period 1990 to 2015.

Among the various goals the one which relates to Child Health is MDG-4 with target of reducing the under five mortality by two thirds between 1990 and 2015. For India MDG 4 has envisaged reduction in Under Five Mortality Rate (U5MR) from an estimated level of 125 per 1000 live births in 1990 to 42 per thousand live births by 2015.

While tracking the progress under MDG 4, in addition to U5MR, the other indicators being considered are Infant Mortality Rate and Immunization for Measles. Linking the tracking of U5MR with IMR, implicitly the target for IMR was also assumed to be reduced by two-thirds between 1990 and 2015. This presumption on the face of it appears to be unsound. Highlighting the inconsistencies in the goals for U5MR and IMR for MDG 4, the paper attempts to rationalize the target for IMR.

This paper also examines the trends in U5MR towards achieving the targets under MDG4. India has reached the level of 53 by 2013 and tends to reach 48 by 2015, missing the target by 6 points. However, considering the continuance of the annual rate of decline witnessed in the recent years, India is likely to achieve the target by 2020.

2. Material and Methods

The time series information for U5MR is available in UN and World Bank reports. Importantly, the information on IMR from 1971 onwards is available through Sample Registration System (SRS), Office of Registrar General of India (ORGI), New Delhi.

The relationship of U5MR and IMR has been studied with a view to rationalize the target of IMR for MDG-4.

In order to track India's journey of achieving MDG-4, detailed analysis has been attempted using the data for the period 1971 to 2013. Further, to study the changing trend in different periods and tracing the path, the entire time period of 1971 to 2013 has been split into three parts as under:

1. Years 1971 to 1990, i.e. Pre MDG period
2. Years 1990 to 2000, i.e. Early MDG period corresponding to year when MDGs targets were fixed
3. Years 2000 to 2013, i.e. Late MDG period after the MDG targets were fixed
4. Years 1971 to 2013, i.e. Entire period

The declining trend in U5MR & IMR has been estimated for each of these time periods, by fitting linear and exponential regression curves. Further the fitted regression estimates are then used in extrapolating the year by which India's MDGs 4 targets would be achieved.

For this, the appropriateness of a regression analysis has been examined.

3. Results

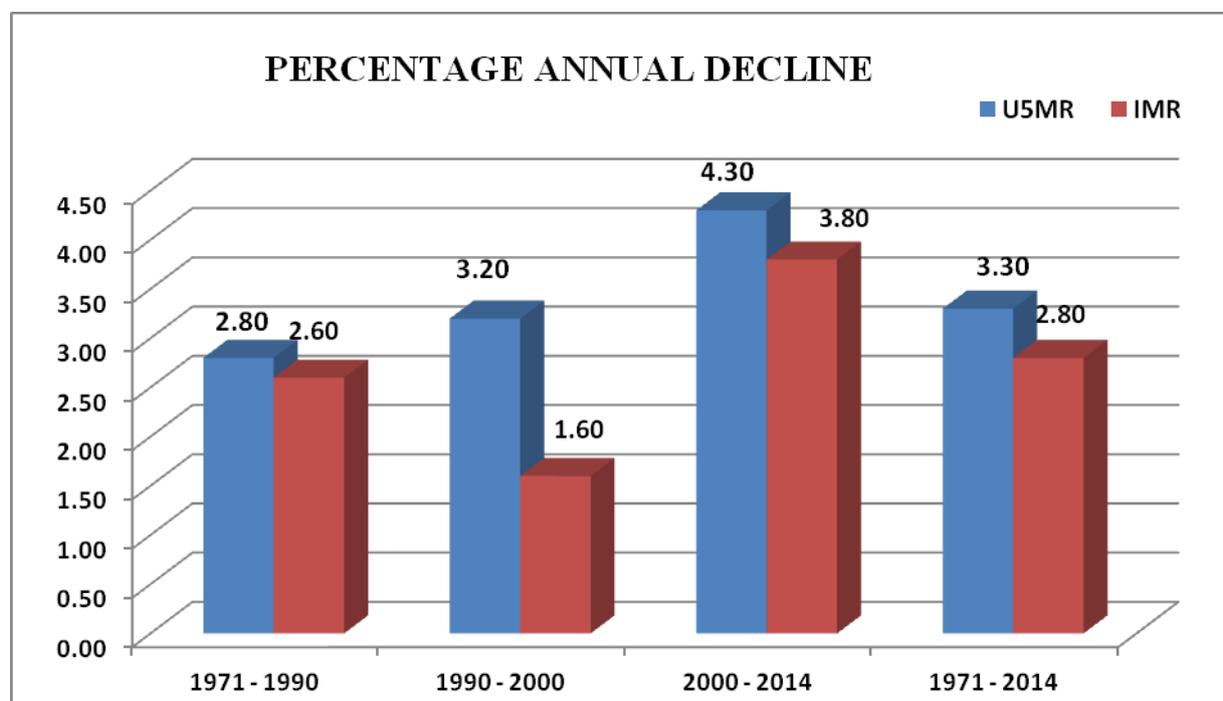
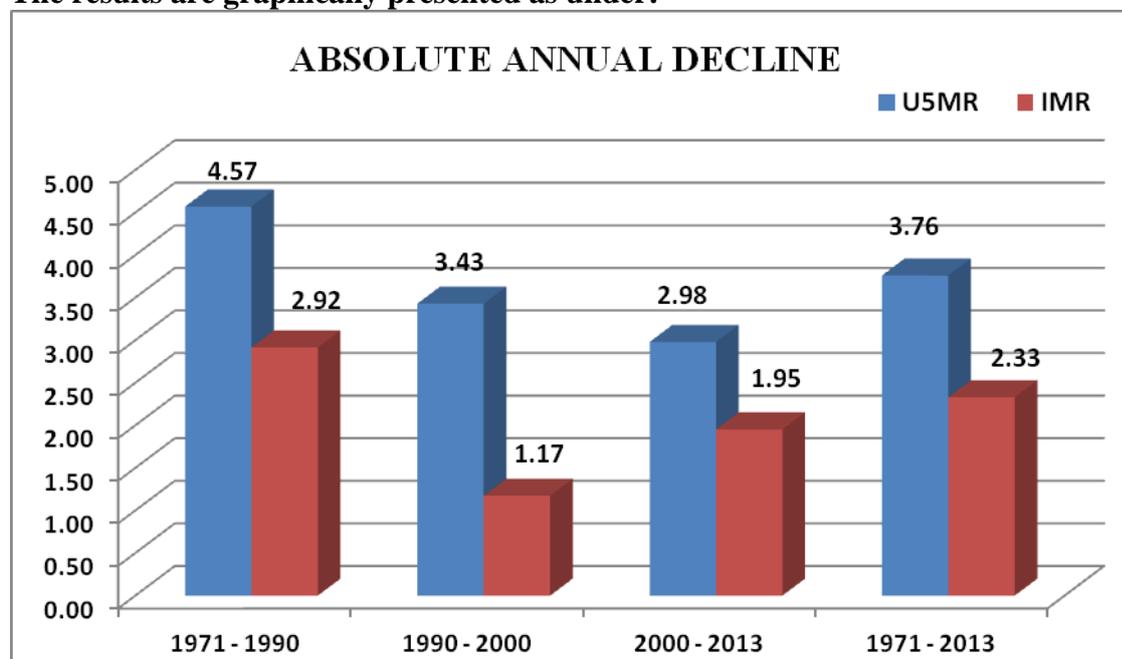
Tables 1 & 2 provide the details about fitted regression curves for U5MR and IMR

Table 1: Trends in U5MR			
LINEAR REGRESSION			
Sl. NO	PERIOD	REGRESSION LINE	R²
1	1971 – 1990	U5MR = 214.729 – 4.572T	0.997
	1990 – 2000	U5MR = 129.411 – 3.438T	1.000
	2000 – 2013	U5MR = 93.268 – 2.988T	0.999
	1971 – 2013	U5MR = 206.278 – 3.768T	0.997
EXPONENTIAL REGRESSION			
Sl. NO	PERIOD	REGRESSION LINE	R²
2	1971 – 1990	LOG U5MR= 5.394 – 0.028T	0.998
	1990 – 2000	LOG U5MR = 4.875 – 0.032T	0.997
	2000 – 2013	LOG U5MR = 4.565 – 0.043T	0.999
	1971 – 2013	LOG U5MR = 5.453 – 0.033T	0.991

Table 2: Trends in IMR			
LINEAR REGRESSION			
Sl. NO	PERIOD	REGRESSION LINE	R²
1	1971 – 1990	IMR = 143.916 – 2.916T	0.923
	1990 – 2000	IMR = 81.036 – 1.173T	0.911
	2000 – 2013	IMR = 69.310 – 1.953T	0.980
	1971 – 2013	IMR = 137.340 – 2.337T	0.970
EXPONENTIAL REGRESSION			
Sl. NO	PERIOD	REGRESSION LINE	R²
2	1971 – 1990	LOG IMR= 4.994 – 0.026T	0.922
	1990 – 2000	LOG IMR = 4.397 – 0.016T	0.917
	2000 – 2013	LOG IMR = 4.272 – 0.038T	0.972
	1971 – 2013	LOG IMR = 5.014 – 0.028T	0.984

The regression co-efficient under linear regression indicates the magnitude of annual decline in absolute points. But the co-efficients under exponential model indicate the rate of decline. For India's U5MR and IMR both linear and exponential regressions fit very well. As globally experienced U5MR / IMR declines are non-linear since mortality cannot keep declining linearly, hence, exponential regression curves seems to be more appropriate.

The results are graphically presented as under:



Additionally for the entire time period, the annual rate of decline was regressed with time. The results are as under:

REGRESSION: Rate of Decline (U5MR) = $0.020 + 0.001T$ $R^2 = 0.872$
REGRESSION: Rate of Decline (IMR) = $0.010 + 0.001T$ $R^2 = 0.055$

Evidently, the U5MR series seems to have been smoothened and hence the fit is good. However for IMR the fit is very poor indicating no trend.

Trend in U5MR

It is important to highlight that MDG4 envisages reduction in U5MR by 66.7% in a period of 25 years. Historically this level of decline was witnessed in a period of 35 years and the period of 25 years yielded only 50% decline. Further the targets were benchmarked retrospectively where 10 years have already passed. It is against this background that the trends and achievements under U5MR are viewed.

In India, Under Five Mortality Rate (U5MR) has declined from the level of 125 per 1000 live births in 1990 to 53 in 2013. The rate of decline has not been uniform.

The rate of absolute decline shows a consistent decelerating trend. The absolute decline was 4.57 points per year during early period 1971 to 1990 which steadily declined to the level of 3.43 points per year during 1990-2000 and thereafter 2.98 points per year during 2000 – 2013. However, in terms of rate of decline U5MR showed consistent increasing trend from 2.8 % per annum during 1971 – 1990 to 3.2% per year during 1990-2000 and thereafter to 4.1% per annum during 2000 – 2013. Thus the pace of decline of U5MR has significantly accelerated during 2000-2013.

This trend is similar to what is witnessed globally. The global annual rate of reduction in U5MR has accelerated steadily to the level of 3.9 per cent between 2005 and 2012.

Year of achieving U5MR target under MDG-4

By using regression estimates, the U5MR has been predicted for 2015. Also the year by which U5MR would reach the target of 42 per 1000 live births has been projected.

Targeted to reduce U5MR to 42 per thousand live births by 2015, India is likely to reach the level of 49 by 2015, missing the target by 7 points. However, considering the continuance of the sharper annual rate of decline witnessed in the recent years, India is likely to achieve the required target by 2020.

Globally the MDG-4 target is likely to be achieved after 2025. Thus, India will be well ahead of achieving MDG-4 in comparison to the achievement of the same globally.

Trends in IMR

In India, the Infant Mortality Rate (IMR) has reduced by nearly 50% during 1990-2012. The level of IMR for 2013 is at 41 per 1000 live births. The decline in IMR has been erratic. Unlike U5MR the annual rate of decline in IMR did not show accelerating trend. The rate of decline was 2.6 % per annum during 1971 – 1990 which came down to 1.6% per annum during 1990-2000 and thereafter rose to 3.7% per annum during 2000 – 2013. However in terms of absolute decline IMR showed similar trend as U5MR

Years of achieving IMR target of MDG-4

By using regression estimates, we have predicted IMR figure for 2015. Also the year by which it would reach the rationalised target of 34 per 1000 live births has been predicted.

It may be pointed out that for the base year of MDG i.e. 1990 the value of IMR of 80 appears an outlier as for 1989-1990 the decline in IMR is 10 points and for 1990-1991 the decline is zero. From the regression equation the value of IMR for 1990 corresponding to U5MR of 125 works out as 87. The trend value of 87 appears to be somewhat realistic and could be used for tracking of targets.

With the increase in the pace of decline for IMR India is predicted to reach the IMR of the level of 39 by 2015 and the MDG 4 target level of '34' per 1000 live births could be achieved by 2020.

Relationship between U5MR and IMR

Table 3 below presents the trend in the ration of IMR and U5MR for India and World for the years 2005-2013

TABLE 3: TRENDS IN IMR/U5MR*100, INDIA & WORLD		
YEAR	INDIA	WORLD
2005	74.8	70.5
2006	75.3	70.9
2007	75.7	71.2
2008	76.1	71.6
2009	76.8	72.1
2010	77.1	72.3
2011	77.7	72.7
2012	78.0	73.3
2013	78.6	73.7

This data indicates that the decline rate in IMR is slower than that of U5MR.

Based on the time series data for the period 1971 – 2013 the regression relationship between U5MR and IMR has been worked out which is given as under:

$$U5MR = -12.328 + 1.580 IMR, R^2 = 0.982$$

Evidently, the fit is good as coefficient of determination is very high (98%).

The relationship between U5MR and IMR though linear is not one-to-one and hence the decline of two-third in U5MR will not correspondingly have a decline of same magnitude in IMR.

From this equation the target of IMR for 2015, corresponding to U5MR target of 42 works out around 34.4.

Alternatively the ratio of IMR to U5MR has been regressed with time and results are as under:

$$\text{Ratio IMR/U5MR} = 64.241 + 0.308T, \quad R^2 = 0.589$$

Making use of the above equation the ratio of IMR to U5MR for 2020 is projected to be about 80%.

Applying this ratio to MDG target of U5MR of 42, the corresponding target for IMR is estimated around 34.

Thus both methods indicate that the target of IMR for MDG-4 needs rationalization at the level of 34 per 1000 live births.

4. Targeted Interventions

India is a vast country with regional and social variations. In view of this the improvements in U5MR and IMR have been uneven. The vulnerable sections of society i.e. Scheduled castes and Scheduled Tribes are lagging behind in availing the benefit of health services.

Social Groups	Share in Population	Share in Births	Share in Neo Natal Deaths	Share in Infant Deaths	Share in Child Deaths
Scheduled caste	18.7	20.9	23.3	23.8	24.6
Scheduled tribe	9.1	9.9	11.0	11.4	12.3
Other backward class	32.4	32.6	34.7	33.9	33.1
Other	38.8	36.6	31.3	31.0	29.8
All India		100.0	100.0	100.0	100.0

Social Groups	Share in Population	Share in Births	Share in Neo Natal Deaths	Share in Infant Deaths	Share in Child Deaths
Scheduled caste	19.2	21.1	25.0	24.5	25.0
Scheduled tribe	8.4	9.8	10.1	10.7	12.7
Other backward class	39.6	40.9	40.2	40.6	40.1
Other	31.9	28.2	24.9	24.2	22.4
All India	100.0	100.0	100.0	100.0	100.0

From the above table it is seen that the Scheduled castes and Scheduled Tribes who together have share of about 26% in population have 38% share in the Under Five Mortality.

Similarly the Empowered Action Group (EAG) States have higher level of U5MR and IMR as compared to other states.

S. No.	States / UTs	Share in Population	Share in Births	Share in Infant Deaths
1	Bihar	8.6	10.9	10.9
2	Rajasthan	5.7	6.8	8.1
3	Uttar Pradesh	16.5	21.0	27.2
4	Madhya Pradesh	6.0	7.4	9.9
5	Chhattisgarh	2.1	2.4	2.6
6	Jharkhand	2.7	3.1	2.8
7	Uttarakhand	0.8	0.8	0.7
	Share EAG States	42.41	52.52	62.2
	All India	100	100.0	100.0

The 7 EAG states which account for 42% share in population have 62% share in Infant deaths.

Thus in order to achieve higher gains, the EAG states and vulnerable sections of the society need to be properly and effectively targeted. With these the MDG-4 could even be realized earlier than 2020.

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