DECISION SUPPORT SYSTEM FOR MATERNAL AND CHILD HEALTH SYSTEM STRENGTHENING

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Abstract

Maternal and Child Healthcare (MCH) has always been regarded as one of the important issues globally. In presence of officials from 189 countries at the Millennium Summit of United Nations (UN), eight targets were set up for eradicating extreme poverty, upholding human dignity, and abolishing inequity in basic human rights such as health, education, etc. and those targets were titled as Millennium Development Goals (MDGs). Among eight MDGs, fourth and fifth targets were reduction of child mortality and improvement of maternal health respectively. Post 2015, UN General Assembly again proposed seventeen new targets named as Sustainable Development Goals (SDGs). Among them, the third target is promoting healthy life for all at all ages.

Throughout last decade, progress of both maternal and child mortality rates have been monitored by several researchers. Each study has depicted that only less than 26% of low and middle income countries (LMICs) were on track to achieve targets as prescribed by MDG4 & MDG5. Worldwide average annual rate of reduction for both U5MR & MMR was observed around 2.2% and 1.9% respectively as on 2011, whereas to achieve targets respective rates of reduction should be minimum 4.4% and 5.5% annually. Maternal and child health condition is very poor in India too. A fifth of maternal deaths and a quarter of child deaths in the world occur in India. U5MR of India on 2011 was 60.7 per 1000 live births and annualized rate of decline was 3.0%. MMR on 2011 was 186.5 per 1,00,00 live births with annualized rate of decline of 4.9%. States like Arunachal Pradesh, Manipur, Tamil Nadu, West Bengal, Kerala, and Maharashtra appeared close to the MDG targets. But improvement in north-eastern region, northern region, and central region of India were not satisfactory.

From above research evidences, it can be comprehended that there are differences in healthcare indicators among regions and it is much more alarming that reduction rates of indicators were comparatively much lower at regions where mortality rates were higher. Inequity in coverage of

healthcare interventions is one of the major obstacles for achieving targets like MDGs or SDGs. Without reducing inequity among regions, overall healthcare improvement will not be possible. Proper utilization of MCH interventions is very important for reduction of inequity in MCH indicators among different regions. MCH interventions get circulated among society through different healthcare service facilities like hospitals, primary health centres, sub centres, community health workers etc. Availability of healthcare services is an important factor which determines healthcare condition of a region. Though having proven healthcare interventions for both mothers and children, coverage of interventions cannot be scaled up as per desired volume due to weak and fragmented healthcare services in LMICs.

Previously health system was usually conceptualized as monolithic systems. System wide interactions among its components were seldom got scrutinized by researchers. For improvement of MCH condition, maximum interventions were designed and evaluated based on their effects on single or couple of health system building blocks. Researchers have promoted 'Systems-thinking approach' for overcoming health system related issues of a region before development of suitable policies or action plans. Mutale and team have applied systems thinking approach to find out internal linkages among six health system building blocks in Zambia. Rwashana and team have tried to find out influencing factors related with neonatal mortality rates by analysing the complex health system with the help of Causal Loop Diagrams (CLD) and systems dynamics modelling. Developing CLDs by applying systems dynamics for a real-world scenario is not very easy. It requires sufficient amount of expertise of the subject.

Therefore, aim of the research work was to propose an alternative analytical framework for reduction of inequity among regions by generating knowledge about health system building blocks applying systems thinking approach and also to develop an interactive knowledge discovery based decision support system on web platform which would facilitate healthcare policy makers to integrate the analytical framework in the process of decision making. For achieving aim of the research work, three interim objectives have been prepared. First objective was identifying all relevant variables under three major categories, i.e MCH interventions; Educational, Social, and Economic (ESE) parameters; and Health System (HS) building blocks category. Second objective was preparation of the alternative analytical framework and third

objective was development of the DSS for incorporating the proposed framework in the process of healthcare policy making.

Under first objective, total 83 variables have been selected through extensive literature review. Number of variables selected under MCH interventions, ESE parameters, and HS building blocks category were 27, 16, and 40 respectively. The analytical framework, developed under second objective consists of three successive steps. First step was segmentation of regions based on their MCH conditions. 16 ESE parameter variables have been utilized and hierarchical clustering technique has been used for segmenting regions based on their healthcare conditions. Second step was identification of key influential MCH interventions which had high impact on MCH indicators, separately for each segmented region. In this step, decision tree algorithm CART has been used for classifying 27 MCH interventions with respect to three MCH indicators, i.e. Infant Mortality Ratio (IMR), Maternal Mortality Ratio (MMR), and Under-five Mortality Ratio (U5MR). Total nine prediction models have been prepared for all three segmented regions, clustered in the first step. The third step of the analytical framework was to find out all frequently occurring HS building blocks and their availability conditions when coverage of any of the influential MCH interventions was either poor or moderate or good at any region. For executing this step, association rule mining technique has been applied on 40 HS building blocks.

A knowledge discovery based interactive DSS has been developed on Web platform by imbibing steps of the proposed analytical framework. For development of the DSS, Shiny app of R statistical software has been used. Separately three modules have been developed for all the three steps under the proposed analytical framework. 602 Indian districts data has been collected for validating applicability of the framework. All data has been collected from nationally conducted surveys like Sample Registration Survey 2012, Annual Health Survey of India 2012, and District Level Household Survey part three (DLHS-3).

Total five modules have been developed under the DSS. The first module has been developed for generating comprehensive knowledge about all the identified 83 variables. The second module would compute correlation among any two variables either from within category or from different categories. The third module has been developed for clustering regions based on their

MCH conditions. This module has been developed based on the methodology described in the first step of the analytical framework. The fourth module has been developed based on the second step of the analytical framework for identifying key influential MCH interventions, which had high impact of MCH indicators, separately for each segmented region. The fifth module would help healthcare policymakers to understand the probability of occurrences of different healthcare service elements when coverage of influential MCH intervention was either poor or moderate or good at any region. This module has been prepared based on the third step of the proposed analytical framework. Expert opinion surveys have been conducted for validating the efficiency of the analytical framework as well as for checking the efficacy of the DSS developed in this research work.

The research work has proposed an alternative analytical framework for applying systems thinking approach in maternal and child health system strengthening. Results have confirmed that the proposed analytical framework would help healthcare policy makers to generate holistic understanding about MCH related elements separately for good, moderate, and poor performing regions before preparing strategic action plans for reduction of inequity among regions. Major advantages of the developed DSS is that it would facilitate policy makers in application of the proposed framework in decision making and users need not to be expert in statistical or data mining techniques for using the system.