Operations Research in Public Health

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Abstract

Operations Research (OR) is gaining importance in public health interventions and programmes increasingly both nationally and internationally. The focus of these research techniques is to constantly guide the programme implementation to achieve best results. It modulates inputs and processes involved in the programme cycle and strive to produce optimal gains in achieving targets and goals. Utilizing the vast range of qualitative and quantitative tools, this research has produced significant results worth applying and testing in the real field. It also identifies problems; often programme managers encompass in operations of public health goods and test the feasible solutions for them. This paper highlights the relevance, themes, and methodological approaches in context to OR in public health. Multiple research and training opportunities currently exist locally and globally, to carry out OR for bringing out timely improvements.

Key words: Public health, Operations research, Programme improvement

In a path-breaking field trial conducted in district Gadchiroli, Maharashtra, West India (1993–2003), Bang and coworkers demonstrated the success of home-based neonatal care (HBNC) package to address the neonatal mortality in this extremely underdeveloped district.[1] The study was conducted in 39 intervention and 47 control villages in the district. The intervention comprised mainly building capacity of village level workers enabling them to detect and manage common neonatal problems such as birth asphyxia, premature birth or low birth weight, hypothermia, breast feeding problems, and neonatal sepsis through making repeat visits to households with neonates according to a predecided schedule in the first month of life. The intervention successfully demonstrated significant declines in the neonatal, infant, and perinatal mortality rates. On the basis of success achieved in the study, coupled with international evidence on the same, two more projects were initiated in the country as replication studies of the Gadchiroli model to test the worth of HBNC in wider context—the ANKUR project (2001–2005) through NGOs in seven sites based in Maharashtra[2] and Indian Council of Medical Research (ICMR) multi-centric study in five sites.[3] Similar successes achieved through these sites enabled policy makers in India to adopt HBNC in few districts of India as a strategy to combat neonatal mortality in India. New operational concerns confront this time tested intervention:[4] Can this method be adopted in wider approach as compared to the project mode implementation? Can accredited social health activist (ASHA) as a new village level worker, if trained be able to implement this strategy under National Rural Health Mission? What effective models of training to be adopted for training these workers? What problems will be faced in implementation of this strategy in different areas? What precautions to be taken to maximize the benefit of intervention? Can the Nation as a whole implement this and will that lead to achieving reductions in Neonatal Mortality Rate? Starting from the case of evidence generated through the HBNC Gadchiroli model, its replication to other sites and operational and implementation concerns cited above, all fall under the broad ambit of operations research (OR).

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Multiple definitions have been put forth for this type of research by many researchers and organizations, owing to its multidisciplinary nature. A global meeting held in Geneva in April 2008[5] resulted in a consensus definition of OR in context to public health as "*Any research producing practically usable knowledge (evidence, findings, information, etc.) which can improve program implementation (e.g. effectiveness, efficiency, quality, access, scale up, sustainability) regardless of the type of research (design, methodology, approach) falls within the boundaries of operations research*". It is a science for better. Keyword in this research is improvements—the research tools are utilized to bring about improvements in performance of prevention and management disease control programmes. By identifying problems in a timely manner, OR can aid in generating evidence-based solutions for these problems and can support policy makers and implementers to act according to these workable and feasible alternative strategies to yield maximum dividends in public health. In a scenario where optimal utilization of resources is desired, as the case in most of the nations, OR can synthesize information for investing in best pathways to overcome programme implementation bottlenecks.

Operations research can deal with wide ranging issues in public health—health system, disease prevention, and control along with community issues. The problems of poor coverage of interventions, quality deprived systems, not reaching vulnerable population with services, difficulty in scaling are solved by innovative mechanisms through OR. In a typical logic model of the health programme cycle comprising of inputs (necessary basic resources for services—technical and financial), processes (programme activities such as training, logistics, etc.), outputs (results at the programme level—services, service use), outcome (results at the level of target population—behavior, practices) and impact (ultimate effect of project in long-term); OR typically tries to modulate inputs and processes in programmes and aims to measure the desired changes in outputs, outcomes and impact. It is this intention that distinguishes it from other types of research. Due to the broad inclusion of service factors that are amenable for research and decision making, multiple names have been coined to describe this research namely operations, operational, implementation, action, health systems, health service, health practices, and decision-linked research.

Another important characteristic of OR is that it gives context-specific answers. If one intervention with some factors, work in one geographical context, does the same intervention will work in another location? What critical approaches will be required for successful implementation of the intervention in different areas and what will the reasons be for achieved successes and failures, OR attempts to answer these public health dilemmas. Also, community contextual factors aiming to enhance the acceptability of services, increasing awareness about disease and its control measures, reducing stigma toward diseases are often targets of OR studies.

Like any other research, OR process typically begins with identification of problems and its statement culminating to writing a good research question, without which a focused OR could not be planned. Possible solutions for these problems are listed from past experiences and other available evidences. The best alternative solution to a problem becomes the piece of research aiming to identify the worth of this solution. Sometimes identifying problems can only be the area of research. If research yields positive outcomes, disseminating to appropriate audience and converting to practice in fields remain the ultimate goal of OR to benefit larger masses.[6]

Does OR always require complex mathematical modeling techniques? Since it has wide applications and many sectors have used these approaches, it is commonly believed by the researchers that executing OR studies require complicated analytic designs and methods. The typical OR studies in other sectors have incorporated the modeling theories to find suitable alternative solutions to complex problems,[7] but in public health approach such use might not be necessarily warranted. The simple epidemiological tools and designs still aptly can be applied to find out suitable answers. One of the positive strengths of OR is that it is not methodologically defined, as earlier also stated in the consensus definition of OR. The techniques that are used in quantitative and qualitative research all can be applied in OR for finding out alternative solutions to common problems.

There are two main approaches for carrying out OR studies in public health. Many distinguished OR scientists in public health strongly believe in secondary data analysis as retrospective record reviews, utilizing data that is already generated in the programmes. Such data in the field often are not used to its maximum potential and much problem identification and gaps can be found out by reviewing the programme reports and data sets. This also

leads to saying that programme managers are important stakeholders in conducting OR and their involvement is critical to guide steps in OR. Often meaningful recommendations in public health strategies have been generated through this approach. The global public health decision including in India to switch over from three sputum smear examination to two smear in diagnosing pulmonary tuberculosis stemmed from laboratory register records reviewed retrospectively looking for additional gains by performing third smear over second in these patients.[8] The advantage of secondary review always remain in getting information easily in least possible time as reports are regularly generated in public health programmes. These studies also pose minimum ethical challenges for their approval.

The second approach is carrying out the primary level research. There are four types of operation research studies as defined by the Population Council[9]—exploratory/diagnostic, field intervention, evaluative and cost effectiveness studies, all not always mutually exclusive but often linked.

Exploratory study

Exploratory studies are carried out to find out the extent of problem; they help in problem identification, often the first step in research. Formative research/need assessment studies also belong to this category that gathers information about interests, attributes, and needs of populations, though not necessarily, but often conducted before the design of any programme.[10] Typically these studies employ both qualitative methods as interviews, observations and group discussions, and quantitative studies as cross-sectional, case control and cohort studies.

Intervention study

Intervention studies as truly randomized, have been in debate as part of OR[11] or not, but interest is gaining to include this group of the studies as OR. The group usually employs quasi-experimental studies having one or two arms as intervention and comparison non-randomly assigned and truly randomized cluster field trials. Pre–post test (before–after) studies are very commonly employed in intervention research. Randomized experiments when tested yield highest level of evidence on effectiveness and efficiency of new service delivery options, giving best choices for implementation to programme managers and policy makers. A cluster randomized trial was planned in 464 villages in Mahabubnagar district of Andhra Pradesh to evaluate whether neonatal mortality can be reduced through systemic changes to the provision and promotion of health care.[12] Complex interventions for public health involving several interacting components at different levels or groups having varying outcomes are increasingly being evaluated through community trials.[13]

Monitoring and evaluation

Monitoring and evaluation activities as part of OR (M'OR'E) have gained real importance in all national public health programmes today. There are two pieces of M and E defined principally: monitoring as process evaluation looking after inputs, processes and outputs in programmes, and evaluation as outcome/impact evaluation. These require data collection on continuous basis and implementation of program activities at different sites is measured. Often it uses sets of certain predefined indicators which track the progress within the programme. Rapid assessments undertaken within the programmes also allow for any midcourse corrections and incremental improvements are aimed through feedback generated through such studies. One such initiative carried out in two phases was RAHI—Rapid appraisal of innovative health interventions undertaken within National Rural Health Mission by executing studies in six low performing states in India to generate evidence about the performance of newly initiated strategic interventions within health systems.[14]

Economic analysis

Often the last step in intervention and evaluation studies is economic analysis by costing and calculating cost effectiveness ratios of the interventions and looking for less expensive pathways for achieving optimal outcomes, as health systems always are posed with challenge of operating with scarce resources. Few examples of OR studies executed in India are listed in Table 1.

There is an increasing thrust accorded by both International and National agencies to invest resources in OR and guide programme implementation in public health. The global fund to fight AIDS, malaria, and TB allows up to 10% of each grant to be allocated for OR.[20] World Health Organization funds implementation research proposals regularly through its grants programmes. Recently, a call for proposals was announced to support new and

Table 1: Few examples of operations research studies from India

Authors (Ref.)	Type of study	Objective	Results	Programme/Policy relevance
Babu *et al.*[15]	Cross-sectional	To evaluate reasons for treatment noninitiation in smear-positive pulmonary TB patients diagnosed and reported as initial defaulters (ID) in 20 districts of Andhra Pradesh	Of 1304 reported ID, 619 (47.5%) had been placed on treatment. Out of total confirmed (685) ID, 51% were untraceable, 22% had died before treatment initiation, 5.5% were treated privately, and 13.5% had other reasons	Inadequate documentation of referrals, delays in treatment initiation, and registration along with deficiencies in address documentation were highlighted areas for programme improvement
Jha *et al.*[16]	Case control (through record reviews)	To assess the timing, characteristics, and risk factors for default among re-treatment TB cases	Defaults occurred early, before start of continuation phase. Being male, previous history of default during ATT, previous treatment from non-RNTCP providers or DOT at public health facility were key risk factors identified.	The study pointed out to strengthen efforts to improve pretreatment counseling, retrieval mechanisms of interrupters and to increase the proportion of patients treated by community DOT providers
Varkey *et al*.[17]	Non-equivalent control Quasi-experimental	To investigate the feasibility, acceptability, and cost of a new, more comprehensive model of maternity care that encouraged husbands' participation in their wives' antenatal and postpartum care in Employee State Insurance Corporation (ESIC) dispensaries in Delhi	Significant changes were noted in family planning knowledge and behaviors of both men and women in intervention group. Significant higher client–provider discussions occurred during maternity care in the intervention group. The marginal cost of implementing the intervention per dispensary per year was Rs 50,000 (approx. US$ 1,000)	On the basis of the results, the model was scaled in all the ESIC dispensaries in Delhi
Tripathy *et al*.[18]	Cluster randomized trial	To assess the effect of community mobilization through participatory women's group in improving birth outcomes in underserved tribal clusters of Jharkhand and Orissa	Neonatal Mortality Rate (NMR) was 32% lower in intervention clusters after adjustments	The study underscored the importance of involving women groups as an alternative to just having health worker led interventions for improving NMR
Patel *et al.*[19]	Economic analysis	To ascertain the efficiency of zinc and copper supplementation in the treatment of acute diarrhea under 5 years	The study demonstrated lower cost of treating acute diarrhea, lower cost per unit health and incremental cost effectiveness ratio	Cost savings as evidenced by the study makes a stronger case for micronutrients supplementation as an adjunct therapy to ORS management

ongoing research in context to interventions relevant to Millennium Development Goals 4, 5 and 6.[21] Besides this many international donors fund projects relevant to umbrella aim of OR in different sectors related to health programmes. In India too, public health programmes provide an opportunity to researchers to undertake OR projects. The Revised National Tuberculosis Programme (RNTCP) has set a lead example for formulating guidelines for enhancing OR studies in India relevant to TB research. Priority OR agenda with research questions and model proposals for funding in the year 2009–2010 are available for institutions for drafting their research activities. Financial support is given to researchers by Central TB division, Government of India, if proposals are passed through its respective OR committees. Postgraduates in medical colleges are also encouraged to do their thesis in field of TB, and small grant is allocated to them for supporting their research expenses.[22] National AIDS Control Organization also promotes OR studies and a provision of research fellowship exists for young scientists to be supported by it for intervention and OR context to AIDS.[23] Importance of OR and its conduct in specific areas has also been highlighted in other Indian health and family welfare programmes. Many state governments are now realizing the need for carrying out more OR to answer their health service delivery priority concerns. Indian Council of Medical Research, the major research body of Government of India, also commissions and invites proposals on OR in different thematic areas from time to time.

Capacity building initiatives in India, although on a limited scale, currently in OR are gaining momentum in the country. Short-term training courses are organized as a part of national health programmes and as other short-term training projects. Many medical colleges and public health institutions such as National Institute of Health and Family Welfare, Public Health Foundation of India have organized such courses for researchers. A novel TB operations research training project has been

initiated by WHO—India and USEA (UNION South East Asia regional office) aiming to develop capacity of the professionals associated with RNTCP to undertake programmatically relevant OR to generate appropriate evidence to enhance TB control efforts in the country. The training will be imparted through series of three workshops each of 5–7 days in duration spread over a period of 1 year and candidates will be expected to undertake an OR project under the training.[24] The first global health symposium on health systems research will be taking place in Switzerland in November this year offering a unique platform to researchers for sharing their OR work, strengthening research capacity, and prioritizing research agenda for maximizing universal access and coverage within health systems.[25]

OR is a distinctive instrument leading to greatest benefit to health system end users at lowest cost. Its worth has been well recognized both globally and nationally. Time has come to harness the potential of this research in order to realize the public health targets and goals. Concerted efforts are required from multiple partners and stakeholders to foster and galvanize OR projects in public health. Teams of academicians, policy makers, programme managers, epidemiologists, biostatisticians, community health specialists, and health economists should join hands to execute quality OR to answer public health system relevant problems and solve them timely. Translating the outcomes of the research into practice will lead to a better health system in terms of four A's—accessibility, affordability, availability and acceptability bridging the prevailing disparities and inequities.

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