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Research Article

SYSTEMS THINKING APPROACH IN MALARIA CONTROL: A QUALITATIVE HEALTH SYSTEM STRENGTHENING INTERVENTION

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A R T I C L E I N F O

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A B S T R A C T

Background: Though 3.3 million deaths from malaria were prevented and lives of three million young children were saved but during the same time, malaria killed an estimated 6,27,000 people. Erratic use of insecticides have created a pool of resistant hygiene chemicals. Chloroquine and Artemisin have been used to combat malaria successfully but inappropriate use have resulted in drug resistant malaria. An integrated environmental management may be beneficial but success on such integration go beyond the biology and behavior of the individual human being and lot has largely remained unexplained. Systems thinking, is a tool that goes beyond this typical algorithm of input-output and is primarily a way of thinking in approaching constraints and in designing solutions. WHO has described six clearly defined interactive building blocks as a convenient device for exploring the health system and understanding the effects of interventions. Systems thinking is best understood by a causal loop diagram (CLD) model.

Methods: We included qualitative research and reviews dealing with programmatic constraints and solutions for malaria control.

Results: Costs involved and availability of insecticide treated mosquito nets, use of differential irrigation policy, effective use of information technology to report and predict malarial hotspots like insecticide and vector resistance and use of attractants were found to be measures which were deviant from the input-output model.

Conclusion: Understanding the environment in which the disease develops, the complex interrelationship of the variables and the feedback mechanism in which the system works, are required for the health decision makers to develop comprehensive, effective policies.

INTRODUCTION

Background

There has been a substantial reduction in malaria mortality rates globally in the recent years. The decline may be attributed to the emphasis put in by the Millenium Development Goals and subsequent increased funding. Though3.3 million deaths from malaria were prevented and lives of three million young children were saved but during the same time, malaria killed an estimated 6,27,000 people[1]. Each monsoon in endemic areas like Mumbai is still scary as there is an upsurge of number of cases of malaria including death. This paradox of sustainability in control strategies had been a huge limitation. Though there exist tailored region wise resource stratified guidelines for management of malaria, the reason for this high morbidity and mortality remain elusive.

In India, use of insecticides against mosquitoes and drugs to treat infection continue to form the mainstays of malaria control programme.

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However, erratic use of insecticides by different stakeholders have created a pool of resistant hygiene chemicals. Chloroquine is still extremely effective against Plasmodium Vivax malaria and has been used extensively for both the forms for years, but little was done to prepare for its failure. Artemisin based combination therapies, used in the later years, changed this scenario to a great extent, but now we have Artemisin resistant Plasmodium falciparum malaria. Though the main reason for Artemisin resistance is known to be use of monotherapy in the private sector and compliance, other causes may also be responsible[2].

An integrated environmental management of malariaparasite reservoirs, better use of technology in diagnosis and proper management of the casesare required to continue the progress on its control[3]. However, success on such integration go beyond the biology and behavior of the individual human being and lot has largely remained unexplained[4].A control strategy comprises of finding out the cause or the constraints, (or inputs);developingstrategies (or interventions) based on these constraints; and finallyanalysing the effectiveness (or output) of the control programme in the health system[5,6]. So

for malaria control, whenever a breeding site for anophelines have been found, an antilarva is usedor when a positive case of malaria is found, suitable anti malarials are used. However, the connections and interactions among the factors responsible for the breeding or occurrence of a case of malaria are usually not studied in depth.

Systems thinkingis a tool that goes beyond this typical algorithm of input and output and is primarily *a way of thinking* in approaching constraints and further designing solutions. It focuses on the larger picture which might provide long term solutions that are more sustainable solution to the inherent problem. It looks at the entire picture instead of few snapshots and does not merely identify an event's consequence as a quick fix but rather tries to eliminate them[7]. In recent times, public health experts have been exploring systems thinking approach to tackle complex health problems like tobacco control, tuberculosis and obesity.

The Systems building blocks

A system comprises of the organisations, personnel and their actions which are directed towards promotion, restoration and maintenance of health.World Health Organisation has described six clearly defined health systems building blocks e.g. service delivery, health workforce, information, medical products and technology, financing and leadership and are regarded as the mostappropriate tool for exploring the health system and understanding the effects of interventions[5]for achieving the overall goal of health strengthening. The system is all about multiple relationships and interactions within the blocks, how one affects and influences the others, and is in turn affected by them. The linkages, behaviours and barriers that are inherent in this building block system is what is an essential element of systems thinking[8].

Causal Loop Diagram

The interactions of different component in a system is best understood by a causal loop diagram(CLD) model.Once a malaria carrying 'sick person' enters a region of high mosquito density, it provides fertile ground for an epidemic. The sick person is then bitten by an 'adult female mosquito' and the mosquitobecomes infected after a few days. It then bites a person from the 'Susceptible Human Population' and there is an infected person with malaria. The infected person now becomes an 'Incubating Person', and then a 'Sick Person' after a brief period of time. When this 'Sick Person' is bitten by a 'female Adult Mosquito', the cycle starts over again and forms the epidemic loop and the susceptible loop. The adult mosquitoes get a sustainable environment to lay more eggs, giving rise to more larvae, thus forming a reinforcing loop. This reinforcing loop is the most important thread in this system and is balanced by effective disease control measures (early diagnosis and prompt treatment) and mosquito control measures (environmental and insecticidal control)[9].

Unknown Factors in Malaria Control

Weakening of the malaria control programme has been attributed to funding shortages, complacency with poor execution, community non-cooperation and quite a few unknown factors[10, 11,12].A few studies have explored these unknownfactors which weaken the control program. A 'Health Belief Model (HBM)' was used by Netta Beer[13,14] *et al* in two consecutive studies to explore the different perceptions of bed-net use. They found inadequate knowledge ofbed net use and the disruption of the family's daily life to be significant constraints. Discomfort of sleeping under a net during the hot season was one of main barriers that interrupted consistency.Another study from Kenya[3] found the main reason for increased mosquito breeding to be creation of artificial barriers by farmers of paddy fields to increase the holding time of water. Reduction of the paddy flooding time by the administration and rice planting alternated with soya, a dry crop; reduced mosquito population and also improved villagers' diets. Information technology has helped control of malaria in different regions of the world. Malaria Early Epidemic Detection System (MEEDS) and Coconut Surveillance are helping Zanzibar to identify and treat many otherwise undiagnosed malaria cases, identifying hot spots and transmission patterns, and responding rapidly to new outbreaks. These mHealth applications are helping Zanzibar to sustain the remarkable gains it has made against this dangerous and debilitating disease[15].

The Malaria Consortium conducted an innovative project in Cambodia, where SMS was used to provide real time malaria occurrence by including locations of hot spots by grass root health workers so that immediate action could be taken by the administrators and doctors. Similarly, information on Artemisin resistance after three days of treatment and possible occurrence of insecticide resistance was also done with the help of SMS[15,16].

A study[17] at Burkina Faso examined the best possible management option for a febrile patient in a hyperendemic setting, keeping the cost factor in mind, from three alternatives: treating presumptively, testing or refraining from both test and treating as per protocol. The study suggested that a febrile child more than five years should be treated presumptively as in dry seasons, the chance of malaria is very low and hence neither testing nor treating with any regimen is required. In the rainy season, however, the adult patient is to be treated with amodiaquin plus sulfadoxine-pyrimethamine and not tested and not treated with Artemisisn Combination Therapy (ACT). Both testing and ACT therapy are recommended if costs were not an issue.

The Systems Thinking Approach in malaria control

A system is an interconnected network of multiplefactors. The practice of systems thinking starts with understanding the simple concept of "feedback" which shows how different actions can reinforce or balance each other. Each of the factors shares responsibility for problems generated by a system. Thus no "one" factor is solely responsible for changes in a system[18]. Usually the human mind does not have any problem to grasp behaviour of two to three dynamic variables at a time. The problem starts when there are more than three or four variables. It then requires understanding of the human behaviour among different stakeholders[6]. At this stage it is very important to structure these components properly so that we can identify what, how and when to act in complex situations[19]. Systems thinkingthus provides tools to map, measure and understand these complex situations that goes beyond the usual "input-blackbox-output" paradigm. It helps to identify the true blockages and challenges and derive solutions from them, which are more practical. Usually basic control measures are applied, which are like a 'fix' to a problem. For example, providing running water or use of

larvicides to prevent larvae breeding; isolating the sick people from the adult mosquito to prevent spread; and educating health workers to diagnose malaria early and treat them promptly. These are effective control measures in their own merit but they only fix the symptom and does not go to the root of the problem. But these systems do change, they change in repeated cycles and sometime in a complicated manner andwe need a dynamic equilibrium field to understand these changes[20].

System Level and System Wide Interventions

Any health intervention may be of two types - system level interventions and system wide interventions.Use of newer and multiple modalities of insecticide control like affordable use of insecticide treated bednets, specially for women and children in the endemic areas; alongwith effective agriculture/husbandry practices for an effective mosquito control; improving the diagnostic facilities by introduction of Rapid Diagnostic Techniques (RDTs) and universal changeover to Artemisin Combination Therapy (ACT) as standard 1st line therapyare the system level complex interventions.

System wide interventions on the other hand, are interventions which will have far reaching consequences like engaging the community inmalaria case management and vector management more effectively; use of information data and SMS to predict 'hot spots', enhancing vaccine research for prevention of malaria. These will affect all other building blocks like the governance, the information system, the service delivery (by changing the behaviour of the health workers) and increased finance towards research which will involve political will. A systems thinking approach will thus help to anticipate and mitigate such effects while developing interventions and harness synergies within these interventions[5].

CONCLUSION

Systems thinking is a way of understanding the reality that emphasizes the relationships among a system's parts rather than the parts themselves. Thus understanding the environment in which the disease develops, the complex interrelationship of the factors and their resulting behaviour are required to be understood for a positive outcome so that the health decision makers are enabled to develop comprehensive policies[21]. The conventional 'quick fix' model of input, output and impact often fail to address the key determinants. Programme managers often seek to evaluate any diseaseimpact by morbidity and mortality in a disease, neglecting the wider health system synergies, that might, in the end, be more successful in system strengthening necessary to achieve health goals.

References

1. UN Millenium Development Goals. http://www.un.org/ millenniumgoals/aids.shtml Accessed on 26 Aug 2015
2. Greenwood B, Treatment of Malaria: A continuing challenge 2014. *New England Journal of Medicine* 371;5
3. How can Complexity and Systems Thinking end Malaria? Available from http://oxfamblogs.org/ fp2p/how-can-complexity-and-systems-thinking-end-malaria/. Accessed on 17 Jul 2015
4. Midgley G. Systemic intervention for public health. *Am J Public Health.* 2006;96:466-472
5. World Health Organisation Alliance for Health Policy and Research. *Systems thinking for health system strengthening* 2009. ISBN 978 92 4 156389 5. Accessed 14 Mar 2015.
6. Green LW. Public health asks of systems science: to advance our evidence-based practice, can you help us get more practice-based evidence? *Am J Public Health.* 2006 Mar; 96(3):406-9
7. Peter Senge The Fifth Discipline. Published by Anti Hive Media 2015; 282-283
8. Phyllida Travis, Sara Bennett, Andy Haines, Tikki Pang, Zulfiqar Bhutta, Adnan A Hyder, *et al*. Overcoming health-systems constraints to achieve the Millennium Development Goals. *Lancet* 2004; 364: 900-906
9. LR James and FMG Jorge. Evaluating epidemic intervention policies with systems thinking: A case study of dengue fever in Mexico; *Syst. Dyn. Rev*. 15, 119-138, (1999)
10. Justin M Cohen, David L Smith, Chris Cotter, Abigail Ward, Gavin Yamey, Oliver J Sabot and Bruno Moonen. Malaria resurgence: a systematic review and assessment of its causes. *Malaria Journal* 2012, 11:122
11. World Health Organisation 2013. Malaria Control in Humanitarian Emergencies: *An Inter Agency Field* Handbook
12. The malERA Consultative Group on Health Systems and Operational Research 2011. A Research Agenda for Malaria Eradication: Health Systems and Operational Research. PLoS Med 8(1): e1000397
13. Netta Beer *et al*.A qualitative study on caretakers' perceived need of bed-nets after reduced malaria transmission in Zanzibar, Tanzania. *BMC Public Health* 2012, 12:606
14. Netta Beer, Abdullah S Ali, Don de Savigny, Abdul-wahiyd H Al-mafazy, Mahdi Ramsan *et al.* System effectiveness of a targeted free mass distribution of long lasting insecticidal nets in Zanzibar, Tanzania. *Malar J.* 2010 Jun 18;9:173
15. Gordon M. Cressman,Michael V. McKay, Abdul-wahid Al-Mafazy, Mahdi M. Ramsan, Abdullah S. Ali,Issa A. Garimo, Humphrey Mkali,and Jeremiah J. Ngondi. Using Mobile Technology to Help Eliminate Malaria in Zanzibar. *Online J Public Health Inform.* 2015; 7(1): e15
16. Cox *et al*.: Novel approaches to risk stratification to support malaria elimination: an example from Cambodia. *Malaria Journal* 2014 13:371
17. Bisoffi Z. Should malaria treatment be guided by a point of care rapid test? A threshold approach to malaria management in rural Burkina Faso. Plos One 8(3):e58019
18. Ahorlu CK, Dunyo SK, Afari EA, Koram KA, Nkrumah FK. Malaria-related beliefs and behaviour in southern Ghana: implications for treatment, prevention and control. *Trop Med Int Health.* 1997 May;2(5):488-99
19. Capra, F. The web of life, A new synthesis of mind and matter, Flamingo Publishers, UK 1997:288p
20. Dörner, D.The logic of failure: recognizing and avoiding error in complex situations, Metropolitian Books 1997:222p
21. William M. Trochim, PhD, Derek A. Cabrera, MA, Bobby Milstein, MPH, Richard S. Gallagher, BS, and Scott J. Leischow. Practical Challenges of Systems Thinking and Modeling in Public Health; *Am J Public Health.* 2006 Mar; 96(3):538-546