Cost analysis of nutrition messaging intervention through community-led videos in Odisha

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ABSTRACT
This study evaluates the cost benefit of implementing a maternal and child health pilot intervention led by a community-based organization using localized videos. The staff of a community-based organization and its village-level workers were trained on producing and screening short 8-12 minute videos on recommended health and nutrition behaviors among rural communities in Keonjhar district of Odisha, India by the USAID-funded Strengthening Partnerships Results and Innovations in Nutrition Globally (SPRING) project and Digital Green. The community organization was trained by SPRING and Digital Green on key nutrition behaviors that can prevent under nutrition, especially during the first 1,000 days between a woman's pregnancy and her child's second birthday. The study highlights the potential of the recurrent activities of the intervention to be sustained by the community-based organization at low cost. The specific measure of cost-benefit analysis used in this study is cost-effectiveness. The methodology for cost data collection uses ingredient costing and a variation of activity-based costing. Effectiveness is measured in terms of knowledge retention of the disseminated messages. The analysis found that the unit cost of this intervention was $2.47 (95% CI 2.38-2.56) per successful retention of a disseminated message and suggests lessons on applying cost-effectiveness methodologies for information and communication technologies for development projects.

Categories and Subject Descriptors
K.3 [Computing Milieux]: Computer Uses in Education

General Terms
Economics, Human Factors

Keywords
Odisha, Nutrition, Maternal, Child, Health, Cost Analysis, Social and Behavior Change

1. INTRODUCTION
Despite launching major national-level programs to improve public health and nutrition, India lags behind in its targets for infant mortality rate (IMR) and maternal mortality rate (MMR) [15]. Maternal and neonatal ailments constitute about 14% of India's disease burden [5][4]. The IMR of the Indian state of Odisha is 61 per 1,000 and MMR is 258, higher than the national averages of 44 and 212, respectively [17]. About 71% of pregnant women and 76% of children between the ages of 35 months and 6 years in rural Odisha suffer from anemia [8]. About 50% of children below 6 months of age are not exclusively breastfed in rural Odisha. Also, around 45% of children below 3 years are stunted and 41% are underweight in rural parts of the state [8][7].

Innovative approaches for delivering preventive health care messages and promoting social and behavior change among hard-to-reach underserved rural populations are crucial for addressing these challenges. Improving household-level health, nutrition and sanitary behaviors in rural areas, especially that of women and children, has been the focus of large-scale government and non-government programs. Government-supported community health workers like Accredited Social Health Activists (ASHAs) and Anganwadi Workers (AWWs), visit pregnant and lactating women as well as mothers with infants to promote healthy behaviors on nutrition, safe delivery, disease prevention, and sanitation. An evaluation of the Government of India's flagship National Rural Health Mission's behavior change campaign [3] recommends greater use of localized regional content and avoidance of information overload and jargon used by government health workers. The report suggests the use of complementary interpersonal communication channels to improve the effectiveness of messaging and highlights the potential of information and communication technology (ICT) to achieve higher coverage and effective information delivery. Several studies have been conducted to gauge the feasibility of using ICT solutions in development programs focusing on areas such as health care, education and agriculture. Mathur et al developed an application for camera phones that was used by rural health workers in two states of India, Karnataka and Rajasthan, to explore the potential of combining camera phones with projectors as a viable low-cost content creation and projection device. The team found that videos could be produced and shared to improve health care delivery, regardless of a community's level of education, cultural background, and exposure to technology [13]. Ramachandran employed persuasive videos on health messages which were disseminated to women by ASHAs through their phones during home visits [18]. She found that such messages could empower ASHAs to become better counselors, if the videos were contextualized to suit the socio-cultural context of the viewers and addressed existing knowledge gaps on behaviors. Though promising, there is a growing need to measure the effectiveness and sustainability of these health delivery channels supported by ICTs.

2. ABOUT COST EFFECTIVENESS

Cost-effectiveness analysis (CEA), developed in the United States in the 1950s to adjudicate costly weapons systems, has found increasing use in evaluating the efficiency and effectiveness of government programs in health, education and other developmental fields [12]. CEA provides information that is vital for making an informed choice between different alternatives and links the effectiveness of a particular intervention to the resources expended on it. Policymakers can consider the cost-effectiveness ratio of a particular intervention as the "price" of purchasing a unit of health by applying it [11]. This information can also be used for comparison and evaluation purposes across multiple interventions having similar outcomes measures for interventions and can have a pivotal role in determining allocations for a government's resource-constrained budget.

In India, CEA studies have been, *inter alia*, used to analyze interventions addressing major diseases [21]. These studies highlight that India has the potential for improving the health of its people at a relatively low cost. Devoting one percent of the country's GDP to a well-designed health program nationwide could save as many as 480 million healthy years of life [2]. Mishra and Nair conducted a systematic literature review of 132 cost effectiveness, cost analyses, and burden of illness research studies of health programs in India [16]. The survey found that there is a need for better assessment of healthcare resources in India. Several CEA studies on ICT for development programs have been conducted. Kenny et al suggest that government poverty alleviation programs that use direct communication channels like radio, television, and mobiles for the poor are more cost-effective than programs pushing for universal access to Internet [7]. Casaburi et al performed a randomized control trial to study the costs and benefits of sending SMS-based agricultural alerts to small-scale sugarcane farmers in Kenya [1]. The SMS messages served as advisories to farmers about the need to complete a task on the plot. The intervention resulted in a net increase in farmer earnings by $54 while the per-farmer cost of the program was about $0.3 per farmer. Gandhi et al applied the community-led video approach featured in this note in a controlled setting in 16 villages in Karnataka, India [4]. They found that the approach, when applied to share agricultural knowledge with farmers, was 10 times more cost-effective than a conventional extension system in which extension workers conducted periodic trainings to farmers. A similar approach that involved providing extension services to 131,000 rice farmers in Bangladesh through VCDs cost $0.38 and resulted in average increases in income of $6.4 per year [21]. This paper estimates the cost of applying a human-mediated community-led video approach to affect the knowledge of rural communities on improved nutrition behaviors.

3. THE PILOT PROJECT

In 2013, Digital Green partnered with the USAID-supported Strengthening Partnerships, Results and Innovations in Nutrition Globally (SPRING) project to apply its human-mediated community-led video approach to promote practices to improve maternal, infant, and young child nutrition (MIYCN) in the Keonjhar district of Odisha, India. A key focus was to promote positive behaviors among pregnant and lactating women and mothers of infants.

Digital Green was already working with Voluntary Association for Rural Reconstruction and Appropriate Technology (VARRAT), a non-profit organization working in Keonjhar, Odisha, since 2010 and had trained its community workers on producing and disseminating videos related to agricultural practices among self help groups (SHGs) that VARRAT had mobilized in 130 villages. In the pilot with SPRING, nutrition practices were introduced into this agriculturally focused intervention in 30 additional villages.

The pilot was implemented to primarily evaluate the feasibility of extending Digital Green's approach in supporting the exchange of knowledge related to improved nutrition behaviors among rural communities. Videos on 10 key MIYCN practices were shared by VARRAT's community workers among 109 women-led SHGs in 30 villages of Keonjhar, Odisha. VARRAT managed the field activities for the project and engaged community workers in each village. These community workers facilitated the screening of videos during SHG meetings to spur conversations with women to adopt improved MIYCN behaviors. SPRING supported VARRAT with training on improved nutrition behaviors, while Digital Green helped VARRAT operationalize its video-enabled approach. SPRING and VARRAT also oriented government health workers in the vicinity of the intervention area. The pilot activities included: (i) conducting a formative research study in Keonjhar to identify nutrition and hygiene behaviors that could be affected in a short duration by SPRING; (ii) designing manuals on nutrition and hygiene behavior and facilitation for trainings of community health workers by SPRING; (iii) regular check-ins of VARRAT staff on project progress by Digital Green; (iv) training on nutrition practices for 23 VARRAT community workers, four VARRAT staff, 40 AWWs and 38 ASHAs, jointly by VARRAT and SPRING, based on the manuals[1]; (v) training of four VARRAT community workers on video production by Digital Green and VARRAT; (vi) training an additional 12 community workers on facilitating the dissemination of these videos among SHGs by Digital Green and VARRAT; (vii) shooting and editing of videos by community workers and supervision of video production process by VARRAT staff; (viii) facilitation of video screenings and household visits to collect information on MIYCN related knowledge retention and behavior change by community workers and coordination by VARRAT staff; (ix) Collation and entry of data from household visits in a management information system by VARRAT staff; (x) documentation of project activities and progress by VARRAT staff; and (xi) administrative support to community workers and VARRAT project staff. Of the activities listed above, the formative research study and the trainings pertaining to nutrition and hygiene behaviors as well as video production and screening were one-time activities. That is, VARRAT now has the capacity to assume SPRING's role to train community and government workers using the developed manuals. In addition, VARRAT now also is able to assume Digital Green's role to train community workers on how to produce and disseminate videos. The activities that VARRAT needs to sustain the program are those listed between (iv) and (xi) above. This CEA study estimates the recurring unit cost for VARRAT to maintain the intervention.

4. COSTING QUESTIONS AND METHODOLOGY

The specific measure of cost-benefit analysis used in this study is cost-effectiveness. The methodology for cost data collection uses

[1] These nutrition trainings helped community health workers, ASHAs and AWWSs build their skills on counseling, problem solving, and negotiating with family members on recommended practices and behaviors.

ingredient costing and a variation of activity-based costing [21] [14]. Effectiveness is measured based on an individual's recollection of promoted behavior. The unit cost of knowledge retention is calculated to evaluate the economics of disseminating a message. The key questions considered in this study include: (a) the costs incurred for implementing the approach and (b) the cost per individual retaining knowledge on an improved MIYCN behavior.

Cost data was collected using an ingredients-based approach. This approach was further refined to incorporate features of activity-based costing (ABC) widely used in the manufacturing sector as a tool for understanding the relationship between costs and final products from different manufacturing processes [14]. ABC assigns resources to activities and further activities to cost objects based on their use [14]. Activity-wise costing helps analyze relative efficiencies of different activities and assess if alternate inputs or arrangements can achieve cost efficiency. Economic costs assess the opportunity cost of an input to society whereas financial budgets usually only value inputs at pre-determined prices. Budgeted costs tend to either underestimate or overestimate costs by not accounting for imputed resources, use of volunteers and donations appropriately. This study used economic costs. A set of standardized tools was developed for collecting cost data. Prior to designing the tools, a list of component activities for the pilot was identified, as described in Section 3. This list guided the data collection process and ingredient-wise costing, such as for human resources, equipment, and travel, for each activity that VARRAT performed.

This data was then analyzed in both ingredient and activity-wise dimensions. All prices were converted to 2013 prices using the prevailing GDP deflators and further converted to USD at an exchange price of INR 58.3 per USD[2]. VARRAT's cost data reflects the market prices at which VARRAT incurred them. For human resources, salary figures were allocated to different activities based on the hours that individuals reported spending on them. Staff members had different travel allowances that they were paid monthly. These allowances were apportioned based on the time spent on a particular activity. ASHAs featured in some videos and facilitated some video dissemination. ASHAs do not have a fixed wage rate, so an average daily wage rate prevalent in the area was used to cost their involvement. For VARRAT's office space, the value of the market rent was apportioned based on the time spent by staff in the office for project activities. Trainings were conducted on VARRAT's office premises so no travel costs were incurred. Equipment costs for video production, dissemination and administrative support were annualized over their useful life using the Equivalent Annual Cost (EAC) formula [20]. All costs were obtained from VARRAT's administrative department.

Behavior change communication interventions such as the one featured in this CEA operate on the premise that generating awareness amongst mothers and families can impact nutrition related practices and eventually lead to better health for mothers and children. Studies correlate knowledge of mothers with better health outcomes of the children [6]. For this study, knowledge retention of women was considered as the key project outcome. A knowledge retention survey was conducted in Patana and Ghatgaon blocks of Keonjhar district an average of seven months after individuals had attended a video screening. A sample size of 283 was arrived at for a 5% margin of error and 95% confidence interval based on the total number of individuals who had attended video screenings [9]. A random sample of 320 SHG members was drawn with an expectation of potential non-responses. The final sample size of the survey was 306. A third-party data collection agency coordinated the survey. The collected data was entered in CS Pro and the analysis was performed using Stata. A participant was considered to have retained knowledge on a particular MIYCN practice if she could recite its key components without prompting from the surveyor.

Table 1. Total Ingredient-wise and Activity-wise Recurring Costs for 12-months, 30-village Pilot ($, 2013)

Activity \ Ingredients	Human Resources	Utilities	Travel	Equipment	Total (% of Total)
Trainings*	446	2725			3171 (20%)
Shooting and editing videos	1048	0	106	30	1184 (8%)
Facilitating video screenings and household visits	4346	0	539	702	5587 (35%)
Collating and entering data	1125	0	100	0	1225 (8%)
Documenting and reporting	524	0	111	0	635 (4%)
Administrative support	2817	840	153	121	3931 (25%)
Total (% of Total)	10306 (66%)	3565 (23%)	1009 (6%)	853 (5%)	15733 (100%)

**VARRAT-led trainings on nutrition, video production and video dissemination*

5. RESULTS

The VARRAT-only cost of implementing this one-year project across 30 villages was $15,733. Table 1 lists the activity-wise and ingredient-wise costs of the pilot. The cost of producing videos was $1,184 for the 10 videos and the cost of organizing video screenings was $5,587 across 30 villages. Data entry and reporting accounted for 12% of the total cost, administrative support accounted for 25%, human resources was 66%, and expenditures on the VARRAT office was 23% of total costs. The survey found that 49% of the promoted behaviors were recalled accurately by individuals that were exposed to them. As a result, the cost-effectiveness ratio was found to be $2.47 (95% CI 2.38-2.56) per individual retention of an improved MIYCN behavior.

6. DISCUSSION

Typically, CEA studies focus on assessing a new or additional intervention in comparison with an existing or control practice. In this study, CEA has been used to gauge how the recurring investments in an ICT-based intervention relate to gains in knowledge retention. An understanding of all direct and indirect cost components is necessary while evaluating the ability to sustain a particular intervention. The approach uses ingredient costing and a variation of activity-based costing. The methodology used in this study focuses on collating cost information retrospectively and developing various allocation methods to ascertain the cost of various activities. The unit costs estimated by the study indicate the costs to VARRAT to continue the approach of producing and disseminating videos and monitoring knowledge retention on an ongoing basis. It assumes the intellectual and organizational capacity built during the initial phase of the pilot has the potential of yielding returns continuously without the need to reinvest in doing so again. This

[2] http://www.oanda.com/currency/average

study is a work-in-progress and provides important information to decision-makers on the cost and effectiveness of a video-based intervention for promoting MIYCN behaviors in the Indian context. The study needs further refinement in terms of measuring outcomes, such as adoption of behaviors, in a systematic manner but was constrained by the limited duration of the project and private nature of MIYCN practices. Collecting cost data retrospectively was economical from a study perspective but posed considerable challenges. For example, costs for each activity were identified based on subjective responses from staff members, which could be prone to bias. The study tried to mitigate this by engaging with staff members and administrators to map their workflows before estimating costs.

The application of Digital Green's approach to support MIYCN behavior change communication efforts appears efficient but would require a controlled comparison to measure its gains vis-à-vis other interventions. Future work may focus on estimating health benefits through this approach. The intervention studied in this paper has the potential of not only reducing the financial burden on vulnerable communities, but also improving the efficiency of health care services.

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8. REFERENCES

[1] Casaburi, L., Kremer, M., Mullainathan, S., and Ramrattan, R. Draft: 06 March 2014. Harnessing ICT to Increase Agricultural Production: Evidence from Kenya.

[2] Chow, J., Darley, S., and Laxminarayan, R. 2007. Cost-Effectiveness of Disease Interventions in India. RFF DP 07-53 Resources for Future).

[3] A Concurrent Evaluation of Phase II of the NRHM BCC Campaign. 2009., PFI, MCH STAR, USAID, ORG Centre for Social Research for Ministry of Health & Family Welfare, Govt. of India.

[4] Gandhi, R., Veeraraghavan, R., Toyama, K., and Ramprasad, V., 2009. Digital Green: Participatory Video for Agricultural Extension. Information Technologies for International Development, MIT Press.

[5] *Global Burden of Disease Cause Patterns.* 2010. Institute for Health Metrics and Evaluation.

[6] Imdad, A., Yakoob MY., and Bhutta ZA.2011. Impact of maternal education about complementary feeding and provision of complementary foods on child growth in developing countries.BMC Public Health, 2011, Apr 13;11 Suppl 3:S25

[7] Kenny, C. 2002. Information and Communication Technologies for Direct Poverty Alleviation: Costs and Benefits. Development Policy Review, 2002, 20 (2): 141-157.

[8] Key Indicators for Orissa. National Family Health Survey III. 2005-06.

[9] Krejcie, R.V., & Morgan, D.W., 1970. Determining Sample Size for Research Activities. *Educational and Psychological Measurement*. 30, 607-610

[10] Kumar, C. and Prakash R. 2011. Public – Private Dichotomy in Utilization of Health Care Services in India. Consilience: The Journal of Sustainable Development. 2011: 5(1) 25-52.

[11] Laxminarayan, R., Chow, J., and Shahid-Salles, S.A. 2006. Intervention Cost-Effectiveness: Overview of Main Messages. In Jaimson, D. T. et al ed. *Disease Control Priorities in Developing Countries,* 2nd Ed., New York: Oxford University Press (CH:2) 35-86.

[12] Levin, H. M., *Cost-effectiveness Analysis* ., in Carno,.M., International Encyclopedia of Economics of Education, 2:ed, 1995. y ed. Oxford, Pergamon, (381- 386).

[13] Mathur, A., Ramachandran, D., Cutrell, E., and Balakrishnan, R. 2011. An Exploratory Study on the Use of Camera Phones and Pico Projectors in Rural India. Microsoft Research, Bangalore, India.

[14] McNair, C.J., Institute of Management Accountants. 1998. Implementing Activity-Based Management: Avoiding the Pitfalls. Statements on Management Accounting. Statement Number 4CC.

[15] Millennium Development Goals, India Country Report. 2014. Social Statistics Division, Ministry of Statistics and Programme Implementation, Govt. of India.

[16] Mishra, D. and Nair, R.S., 2015. Systematic literature review to evaluate and characterize the health economics and outcomes research studies in India, Perspectives in Clinical Research, January-March 2015, Vol 6, Issue 1

[17] National Health Mission. Odisha State and Health Profile. Updated 22/09/2014.

[18] Ramachandran, D. 2013. Mobile Persuasive Messages for Rural Maternal Health. In Donner J and Mechael P (Eds). *mHealth in Practice: Mobile Technology for Health Promotion in the Developing World* (pp. 87-99).

[19] Ramachandran, D., Canny, J., Das, P. D., and Cutrell, E. 2010. *Mobile-izing health workers in rural India.* In Proc. CHI '10. ACM Press, 1889-1898. 107.

[20] Tang, S. L. 2003. *Economic Feasibility of Projects: Managerial and Engineering Practice.* The Chinese University of Hong Kong.

[21] Tan-Torres Edejer T, Baltussen R, Adam T, Hutubessy R, Acharya A, Evans D, Murray CJL 2003. Making Choices in Health: WHO Guide to Cost-Effectiveness Analysis. World Health Organization.

[22] Van Mele, P., Zakaria, A. K. M., Begum, H. A., Rashid, H. A., & Magor, N. P. 2007. *Videos that Strengthen Rural Women's Capability to Innovate.* Communication for Development and Social Change, 1(3), 273-293

[23] Wholey, J.S., Hatry, H.P., and Newcome, K.E. 2010. Handbook of Practical Program Evaluation. Josey-Bass. ISBN-13: 978-047052247