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Incremental Cost Effectiveness Analysis of an Electronic Clinical Decision Support System for Improving Quality of Maternal and Newborn Care in Rural Tanzania

Promotionfach: Public Health

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Introduction: Poor quality of care makes birth the riskiest time for women and newborns for death and disability in Tanzania. Poor quality of care is an inefficient use of resources, because the interventions provided are ineffective in themselves. One potential reason for the poor quality of care is the existence of a “know-do gap”, whereby healthcare workers do not perform to the best of their knowledge. Poor performance is very often a result of low motivation among health care providers compounded by shortage of financial and well trained human resources, shortage of infrastructure and supplies, poor transport and communication infrastructure and weak governance and management. The lack of motivation leads to an insufficient translation of knowledge into optimal utilization of resources and more seriously to the provision of suboptimal maternal and newborn care (MNC).

QUALMAT project Tanzania aimed at improving quality of MNC through addressing the know-do gap in selected rural primary healthcare facilities. A previous study had found poor quality of MNC emanating from poor performance (know-do gap) in these health facilities. QUALMAT aimed at increasing provider performance through developing and implementing an electronic clinical decision support system (eCDSS) to help providers comply with World Health Organization’s guidelines during provision of antenatal and childbirth care. This study aimed at assessing cost-effectiveness of the eCDSS in improving quality of MNC compared to the traditional paper-based approach. Potential cost-savings to households from improved MNC quality at primary healthcare facilities is also explored.

Methods: This was a quantitative before-and-after intervention study, part of the bigger QUALMAT research project in which twelve primary healthcare facilities of two rural districts were selected to participate. Lindi rural was the intervention district where eCDSS was implemented in six healthcare facilities, while Mtwara rural was the control district with six healthcare facilities. This study involved four sub-studies. First, analysis of costs related to provision of health services focusing on antenatal care (ANC) and childbirth in the study health care facilities before and after implementation of eCDSS. Second, analysis of costs related to eCDSS installation and operation in the six intervention health care facilities in Lindi. Third, analysis of incremental cost-effectiveness of the eCDSS in improving quality of MNC compared

to the traditional paper-based approach, and fourth, estimation of potential cost-savings to households from improved MNC quality at primary healthcare facilities.

Results: ANC and childbirth consumed approximately 7,140.2 USD and 7,389.5 USD in 2009 and 6,810.9 USD and 6,107.2 USD in 2013 respectively. On average, pre-intervention unit costs were rather high, 16 USD (range 2.8-59.4) per ANC visit and 79.4 USD (range 32.7-211.5) per childbirth. Unit costs show variation in relative efficiency in providing health services between the health facilities. ANC unit costs were influenced by number of staff, structural quality of care, process quality of care and perceived quality of care while childbirth unit costs were influenced by population-staff ratio and structural quality of basic emergency obstetric and newborn care services.

Total financial cost of eCDSS intervention amounted to 209,085 USD for the six health centers. 69% of these costs were incurred in the installation phase and included all the activities in preparation for the actual operation of the system for client care. Generally, training made the largest share of costs (30% of total cost and more than half of the recurrent cost) followed by eCDSS software- 29% of total cost. There was a difference of 19.9% between economic and financial cost of the eCDSS. 90.9% of economic costs were fixed, consisting of inputs whose costs do not vary with the volume of activity within a given range. Economic cost per eCDSS contact was 43.03 USD.

Clinical effectiveness evaluation of the eCDSS indicated a 4.5% and 23.2% change in process quality of ANC and childbirth respectively post-intervention. The eCDSS did not manage to significantly improve the overall process quality of ANC. Improvement in the overall process quality of childbirth care in general was significant at $p < 0.1$. The eCDSS managed to significantly improve individual process quality variables; history taking and continuity of care during ANC; and monitoring mother, inter-personal performance and recording during childbirth.

Incremental cost effectiveness ratio (ICER) varied depending on assumptions made on cost and quality scores. From the models tested, ICER per health facility ranged between 2,469 USD to 3,299 USD per 1% change in ANC process quality while ICER per ANC contact ranged between 5.5 USD to 7.3 USD per 1% change in ANC process quality. ICER per health facility for ranged between 338 USD and 475 USD per 1% change in childbirth process quality while ICER per childbirth ranged between 1.7 USD to 2.4 USD per 1% change in childbirth process quality.

Women reported to have spent a mean total of 51 USD (median 39 USD) giving birth at a hospital. This was higher among those who underwent cesarean section, 64 USD (median 56 USD) compared to those who had undergone normal childbirth, 29 USD (median 22 USD). The mean expenditure represented 27.2% of the national household monthly average consumption

expenditure and 33.1% of the rural household monthly average consumption expenditure. Drugs and medical supplies were the most expensive cost items followed by food and transport. Most companions were farmers reflecting time cost of childbirth to households.

Conclusions and recommendations: The great variability in unit costs of ANC and childbirth service provision between facilities reflects a room for efficiency improvement. High unit costs are mainly due to level of input costs and service utilization in these facilities. The importance of focusing on both providers and consumers of health care in efforts to improve efficiency cannot be over emphasized. A focus should be on improving process quality and putting in place infrastructure for basic emergency obstetric care services. Improvement of human resources in terms of number and competency is also important. A careful analysis of health facilities, including analysis of the health care provision structure, to identify areas with human resource improvement need is vital. Reduction of resource waste through increased utilization of MNC services can improve efficiency of service delivery in those areas operating below capacity. Unit costs for health facilities operating below full capacity are likely to fall with increment in MNC utilization, at least in the short-run as most costs are fixed. Efficiency analyses through simple techniques such as measurement of unit costs should be made standard in health care provision, health managers can then use the performance results to gauge progress and reward efficiency through performance based incentives.

Despite several challenges faced during eCDSS implementation successful adoption and use was eventually realized. Training was the most important activity of the implementation. Health workers need to be well trained for a successful health technology intervention. This training must be accompanied by supportive supervision to ensure right use and consistency. Payment to compensate health workers' time is essential to motivate eCDSS utilization, especially at the outset. However, retention of health workers is an important factor for the success of eCDSS.

Despite having marginal effectiveness on improving process quality of maternal care, the eCDSS had a low implementation cost and managed to significantly improve individual process quality variables. Cost-effectiveness of the eCDSS can be improved through; setting up strategies to ensure retention of trained health care workers to reduce cost of training over-time, payment to motivate eCDSS utilization especially at the outset because the use of the system may be viewed as a double burden by health workers, use of more durable, versatile and cheap devices to reduce eCDSS cost, and using the system in other activities besides MNC, for example in record keeping and reporting. Realization of gains from the eCDSS requires effective implementation and enabling health system.

Households pay substantially during childbirth at high level health care facilities. Strengthening process quality of MNC including basic emergency obstetric and newborn care at primary level

facilities (using interventions such as the eCDSS) may decrease by-passing and financial burden to households.