Mathematical modeling of drug inventory for sustainable pharmacy management in Uganda

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In today’s fast-paced and competitive market place, pharmacies need every edge available to them to ensure success in planning and managing inventory of drugs under demand uncertainty. In Uganda, the capacity to sustain cost-effective inventory of drugs in community pharmacies needs special attention. The paper intends to establish an optimal drug inventory model for sustainable pharmaceutical services in Uganda. The objective of this paper is to determine optimal replenishment policies of drugs so that customer requirements are met at least cost. An inventory model is therefore proposed that optimizes replenishment policies of a periodic review inventory system of drugs under stochastic demand; with particular focus on drugs for malaria in Uganda community pharmacies. We explain a finite state markov decision process model where states of a markov chain represent possible states of demand for drugs. The paper elaborates on the total replenishment, holding and shortage inventory cost matrix that is generated; representing the sustainability of performance for the markov decision process problem. The paper examines two critical replenishment policies that are relevant to the drug inventory problem for sustainable pharmacy management: (1) replenishing additional units of drugs for inventory versus (2) not replenishing additional units of drugs for inventory. Using dynamic programming, the optimal drug replenishment policies are determined over a finite period planning horizon. Preliminary results indicate the existence of an optimal state-dependent drug replenishment policy and the associated inventory costs incurred by the pharmacy chosen in the case study. As a strategy for optimizing inventory of drugs for sustainable pharmacy management under demand uncertainty, computational efforts of using markov decision processes show promising results. The stochastic inventory model proposed can improve pharmaceutical services through timely delivery of drugs in order to support sustainable pharmacy management in Uganda.