Accepted Manuscript

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PII: S2211-6923(14)20047-6
DOI: http://dx.doi.org/10.1016/j.orhc.2015.07.005
Reference: ORHC 77

To appear in: *Operations Research for Health Care*

Received date: 31 October 2014
Accepted date: 18 July 2015

Please cite this article as: P. Bhattacharjee, P.K. Ray, Simulation Modelling and Analysis of appointment system performance for multiple classes of patients in a hospital: A case study, *Operations Research for Health Care* (2015), http://dx.doi.org/10.1016/j.orhc.2015.07.005

Simulation Modelling and Analysis of Appointment System Performance for Multiple Classes of Patients in a Hospital: A Case Study

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Abstract:

Appointment systems for scheduling patients to a hospital facility play an important role in controlling and synchronizing the arrival of patients with resource availability thereby reducing the waiting time of patients and increasing the utilization of resources. In this paper, hospital appointment systems with multiple classes of patients are considered where different classes of patients may vary in punctuality, no-show probabilities, mean service times and service time variability. Classification of patients may help in providing important insights for designing an appointment system considering different sequencing schemes and adjustments of inter-appointment times. For illustration, a case study is conducted for appointment scheduling of patients to the Magnetic Resonance Imaging (MRI) scanning machine of the Radiology department of a multi-speciality hospital situated in eastern India. The patient flows in the system are modelled using discrete-event simulation wherein a number of appointment scheduling policies (combinations of different sequencing and appointment rules) are analysed and evaluated. The performance measures of interest include the waiting times of all classes of patients and utilization of the server (MRI machine). The simple sequencing rule of ordering the patient classes in increasing order of mean service time performs best among all the sequencing rules. The individual block variable interval appointment rule, i.e., scheduling a single patient at a time with inter-appointment times adjusted according to the mean service times of patient class performs best.

Keywords: Appointment scheduling systems, performance analysis, patient flow, multiple classes of patients, queueing theory, discrete- event simulation