

Optimizing Nurse-staffing Strategies for Inpatient Settings Using a Stochastic Modeling Approach

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The Health Resources and Services Administration (HRSA) projects a shortage of 5,900 registered nurses in the state of Kansas and a deficit of 36 percent nationwide by 2020. The national nurse shortage along with rising patient acuity levels have led to an increase in nurse workload, causing nurse workforce to experience high levels of burnout. There is growing concern that nurse burnout could adversely impact the quality of care provided. Consistent evidence from observational studies suggests that inadequate nurse staffing in hospitals and heavy nurse workload threaten patient safety and quality of care. According to the Agency for Healthcare Research and Quality (AHRQ), every additional registered nurse per patient is associated with a risk reduction in hospital-related mortality by 9 and 16 percent in intensive care and surgical units, respectively. To address this issue, hospitals often use recommended nurse-to-patient ratios to staff different inpatient units. However, patients in a unit may have different acuity levels based on the severity of care needed. This may impact the staffing needs of the unit potentially rendering a fixed nurse-to-patient ratio ineffective. In this study, we quantify the impact of patient acuity on staffing needs of an inpatient unit and develop nurse-staffing strategies that take this effect into account. In particular, a stochastic model is proposed and solved to quantify the trade-off between the staffing level of the inpatient unit and different performance metrics such as the probability of excessive delays in providing care, which are used to measure the extent of timely delivery of patient care. Healthcare managers can use the information provided by the model to identify the staffing level that yields the desired trade-off between all metrics for a given patient mix. The proposed model will capture the uncertainty associated with the volume and duration of care for different acuity levels. This will be achieved through the application of queueing theory and discrete-event simulation techniques. The results obtained from applying the model to an inpatient unit demonstrate that patient acuity may greatly impact the staffing needs and that fixed nurse-to-patient ratios can lead to inadequate staffing levels.