A Model to Optimize Followup Care and Reduce Hospital Readmissions after Radical Cystectomy

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Abbreviations and Acronyms

SID = State Inpatient Database

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Purpose: Radical cystectomy has one of the highest readmission rates across all surgical procedures at approximately 25%. We developed a mathematical model to optimize outpatient followup regimens for radical cystectomy.

Materials and Methods: We used delay-time analysis, a systems engineering approach, to maximize the probability of detecting patients susceptible to readmission through office visits and telephone calls. Our data source includes patients readmitted after radical cystectomy from the Healthcare Cost and Utilization Project State Inpatient Databases in 2009 and 2010 as well as from our institutional bladder cancer database from 2007 to 2011. We measured the interval from hospital discharge to the point when a patient first exhibits concerning symptoms. Our primary end point is 30-day hospital readmission. Our model optimized the timing and sequence of followup care after radical cystectomy.

Results: The timing of office visits and telephone calls is more important in detecting a patient at risk for readmission than the sequence of these encounters. Patients are most likely to exhibit concerning symptoms between 4 and 5 days after discharge home. An optimally scheduled office visit can detect up to 16% of potential readmissions, which can be increased to 36% with 1 office visit followed by 4 telephone calls.

Conclusions: Our model improves the detection of concerning symptoms after radical cystectomy by optimizing the timing and number of outpatient encounters. By understanding how to design better outpatient followup care for patients treated with radical cystectomy we can help reduce the readmission burden for this population.

Key Words: patient readmission, cystectomy, postoperative care, ambulatory care

EARLY rehospitalization is under intense scrutiny from clinician leaders and policymakers due their high cost, incidence and preventability.[1–4] Section 3025 of the Patient Protection and Affordable Care Act identified 30-day hospital readmissions as an important metric in measuring

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quality of patient care. Under this section excessive hospital readmissions can be penalized with decreased reimbursements.[4,5] Policymakers will be extending the application of this law to surgical procedures in the near future.[5,6]

With a readmission rate approaching 25%, radical cystectomy for patients with bladder cancer may be a natural target if this policy is extended to surgical procedures.[7,8] Despite multiple studies detailing the postoperative morbidity of radical cystectomy, the readmission rates for this procedure have remained stable over a decade.[7,8] Certain aspects of followup care, including physician office visits and laboratory tests, have been associated with improved survival in patients undergoing radical cystectomy.[9] However, the patterns of followup care associated with readmissions have not been widely studied. Innovative models of optimal outpatient followup after cystectomy discharge may help reduce readmission rates. Ideally, models would be able to predict when a patient is at greatest risk for readmission, thereby informing the optimal outpatient followup regimens. To aid in this process the input of systems engineers may be helpful since they examine time to failure dilemmas across a spectrum of industries. Leveraging their expertise may provide a novel way to reduce readmissions after cystectomy using robust, real-world modeling techniques.

In this study we developed a mathematical model to obtain the optimal post-discharge followup regimen to reduce readmissions after radical cystectomy. Our model examines how 2 common types of postoperative patient encounters (ie office visits and telephone calls) affect readmission rates.

METHODS

Data Source and Study Population

We used the Healthcare Cost and Utilization Project State Inpatient Databases for Florida, Iowa, New York, North Carolina and Washington to identify adults (18 years or older) who underwent radical cystectomy for bladder cancer in 2009 and 2010. Our model incorporated all patients who underwent radical cystectomy and were readmitted to the hospital.

To parameterize our model we required additional intervals for events occurring after discharge from the index hospitalization. Specifically we needed to know the distribution of time from initial hospital discharge to the time when a patient first experiences symptoms potentially causing a readmission. These symptoms include fever, nausea, emesis and postoperative pain, which are not easily discernible in national longitudinal hospital care databases. Therefore, we conducted a retrospective medical record review of radical cystectomy performed at our institution between 2007 and 2012. Two data extractors (NK and BL) independently collected the data to ensure fidelity of the results. We then determined the distribution of the time from index hospital discharge to the onset of symptoms before readmission. The interval from when a patient first exhibits symptoms that precede a readmission to the time of readmission is defined as the delay time.

Delay-Time Model Formulation

We developed an optimization model of outpatient followup practices after radical cystectomy to examine the varying effect of office visits and telephone calls on detecting patients at risk for readmission. Our model is based on a systems engineering methodology known as delay-time analysis. Given the desired number of patient encounters, we determined the optimal followup regimen, which included timing and sequence of office visits and telephone calls.[10] The primary end point of our study is 30-day hospital readmission after radical cystectomy.

Within the framework of delay-time analysis the patient represents the system, any concerning symptoms that develop after discharge indicate defects in the system and readmissions represent failures of the system. We assume that time, denoted as t, has a maximum value of 30 days (based on the current Centers for Medicare and Medicaid Services definition for hospital readmission).[5] As shown in figure 1, a patient discharged home at time t_1 is assumed to be in stable condition. The patient could then become symptomatic at time t_3 but a patient encounter at time t_2 would be considered ineffective (because the patient has not yet experienced any indications that warrant readmission). In contrast, a patient encounter at time t_3 and beyond could potentially identify the symptoms that led to readmission. If the patient is readmitted at time t_5, the delay-time is defined as the time elapsed from t_3 to t_5. We examined the differences in the 2 most common patient encounter practices (ie office visits and telephone calls) used to detect those patients at risk for readmission.

Statistical Analysis

Using this framework we determined the optimal post-discharge monitoring regimens that maximized the clinical detection probability, which is the likelihood of identifying a patient becoming symptomatic after initial hospital discharge. We assumed an office visit is 40% more accurate in detecting symptoms in at risk patients than telephone calls, although we were able to vary this in our model. Sensitivity analysis was performed regarding the detection probability of telephone calls. In our baseline model (which assumes a 60% detection probability for telephone calls) 1 office visit was found to be equivalent to 2.57 telephone calls (see supplementary Appendix,

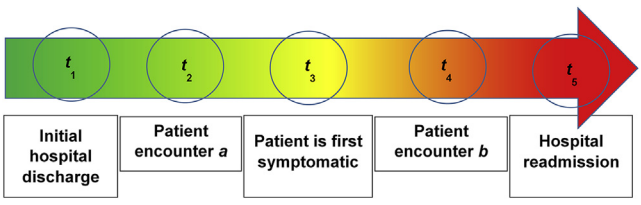

Figure 1. Theoretical basis for delay-time readmission model