

Identifying, Assessing, and Balancing Competing Risks of Multiple Hospital-Acquired Conditions (HACs)

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Statement of the Problem

- Hospital-acquired conditions (HACs) are common, costly, and a national patient safety priority
- In 2010, there were over 5.9 million HACs with an estimate of over \$62.8 billion in incremental hospital costs
- Preliminary data suggests there may be a divergence in progress on CAUTIs and HAPUs compared to falls



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Statement of the Problem (cont.)

- Possibility that hospitals' are focused on interventions that reduce a single HAC not taking into account unintended consequences and trade-offs that may increase the risk of other HACs
- To date, no quantitative assessments of multiple HAC competing risks/tradeoffs
- Absence of decision support tools that consider competing risks of multiple HACs

Objectives

- Develop empirical framework to identify, assess and predict competing risks of multiple HACs
- Assemble a multisite database to implement this empirical framework
- Estimate empirical framework and develop predictions of patient-specific competing risks
- Develop a Multiple HAC Competing Risk Dashboard to inform clinicians, administrators and patients decisions related to indwelling urinary catheter (IUC) use
- Pilot test the Dashboard

Challenges

- Low incidence of CAUTIs in all 21 hospitals
 - Limited the extent alternative empirical specifications could be examined
 - Significantly more UTIs included in diagnosis codes than reported CAUTIs
- Identification of the timing of a UTI diagnosis relative to IUC placement and removal
- Very low incidence of a patient experiencing multiple HACs
- Lack of accepted and validated thresholds for the probability of a HAC to inform dashboard

Empirical Framework

- Adapted a competing risk latent failure time framework
- Specified a Transition Probability Model (TPM) that is flexible and accommodates low incidence failures
- Multistate discrete time-to-event model with patient-day as the discrete time measure
- Health state for each patient-day based on:
 1. The presence or absence of an IUC
 2. Whether experienced a CAUTI or general UTI
 3. Whether experienced a fall
 4. Whether experienced a HAPU

Creation of Multisite Database

- Five health systems merged data from EHRs, incident reporting systems, and NHSN covering 21 hospitals
 - Inpatient admissions with discharge date 10/15-9/16, age 18-100 years, had an IUC at some point in admission, excluding labor & delivery and psychiatric admissions

System	Patient Admissions	# CAUTI/UTI	# Falls	# HAPUs
California	14,835	36/943	110	60
Colorado – 1	29,380	67/1,114	309	230
Colorado – 2	5,481	32/169	76	6
Louisiana	8,591	36/392	188	831
Nebraska	9,344	11/150	9	128

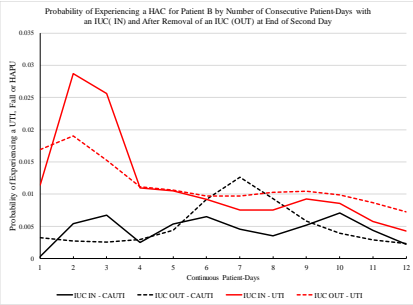
Specification of Outcomes

- Two approaches to measuring UTIs
 1. NHSN definition of CAUTI
 2. General UTI using diagnosis codes and lab results
- All types of falls with all level of injury
- All stages of HAPUs; excluding
 1. Locations on the head, neck, shoulders, arms, hands, chest, abdomen and unspecified
 2. Diagnosed on day of admission or following day
- Catheter-day as a patient-day with an IUC in place for at least three hours

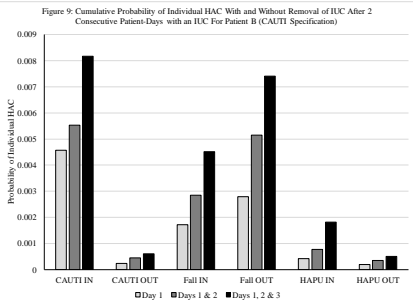
Empirical Results

- Patient characteristics matter
 - Age, sex, race/ethnicity, type of insurance coverage, comorbidities
 - Admission source, catheter present on admission
 - Fall risk scores, pressure ulcer risk scores, in ICU
- Number of consecutive days with an IUC matters
- Hypothetical patient
 - 55 year old White non-Hispanic female admitted from community to medical surgical unit, Braden score on admission 18, at risk for falls, 2 comorbidities, commercial insurance coverage

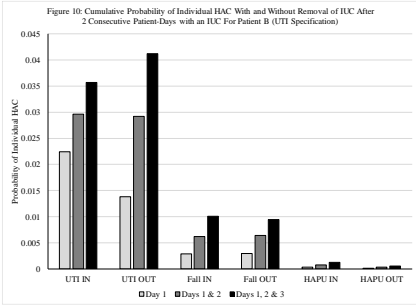
Hazard Rates for Any HAC for CAUTI and UTI Specifications



Predicted Competing Risks – CAUTI Specification



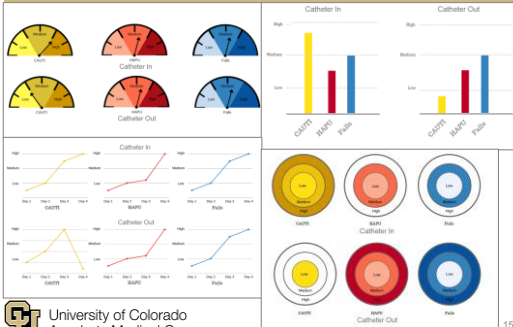
Predicted Competing Risks – General UTI Specification



Multiple HAC Competing Risk Dashboard Development

- Presented 5 low-fidelity dashboards to focus groups of providers, nurses and managers
 - Green, yellow, red gauges
 - Light to dark color gauges
 - Bar graphs
 - Line graphs
 - Bullseye targets
- Consensus preference for green, yellow, red gauges

Example Low-Fidelity Dashboards



Multiple HAC Competing Risk Dashboard Development (Cont.)

- Developed high-fidelity dashboard of green, yellow, red gauges in interactive Excel tool
 - Conducted key information interviews with providers, nurses, and managers at 3 health systems
 - Reviewed alternative colors and thresholds for green to yellow and yellow to red
 - Reviewed alternatives presenting individual and overall HAC risks
 - Reviewed alternatives with values linked to thresholds
- Demonstration of high-fidelity interactive Excel dashboard

Limitations and Next Steps

- Relatively few HACs in over 67,000 admissions, larger number of contributing systems would benefit predictive modeling
- Need improved extraction of event timing from EHRs and incident reporting systems
- Need to identify thresholds for HAC probabilities that are clinically meaningful
- Extension of empirical framework to additional HACs and multiple occurrences
- Integration of predictive model into EHRs

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