

Inpatient Readmission as a Multinomial Outcome: An Investigation of the Independence of Irrelevant Alternatives

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Hospital Readmission & Quality of Care

- Readmissions sign of poor healthcare quality
 - Inpatient care/discharge planning
 - Access/quality of follow-up care
- Target variable for interventions & research
- Hospital Readmissions Reduction Program
 - Medicare payment reform beginning in fiscal year 2013
 - Reduced Medicare reimbursement for all inpatient care if readmission rates are “excessive”
 - Initial focus on heart attack, heart failure, & pneumonia
 - 30-day window likely (common threshold)

Alternative Outcomes to Readmission

- If not readmitted w/in 30 days, patient could ...
 - Die w/in 30 days
 - Visit ED w/in 30 days
 - Have no event w/in 30 days
 - Have combination of the above
- Policy & research focus on outcomes independently
 - Was there a readmission – yes/no?
 - Did patient die – yes/no?
- Implicit assumption: Independence of Irrelevant Alternatives (IIA)

Independence of Irrelevant Alternatives

- Effect of any independent variables on the relative risk between 2 outcomes is independent of any additional outcomes that may be added or removed from consideration.
- In readmission context:
Likelihood of readmission vs. no event is unaffected by the possibilities of dying or returning to the ED
- Implicit assumption in studies of readmission as binary outcome
- IIA is fairly stringent
 - Often violated in practice ==> inconsistent estimates
 - Can be tested and addressed if needed

Research Question

Is the assumption regarding independence of irrelevant alternatives (IIA) valid for the analysis of hospital readmissions and other post-discharge outcomes?

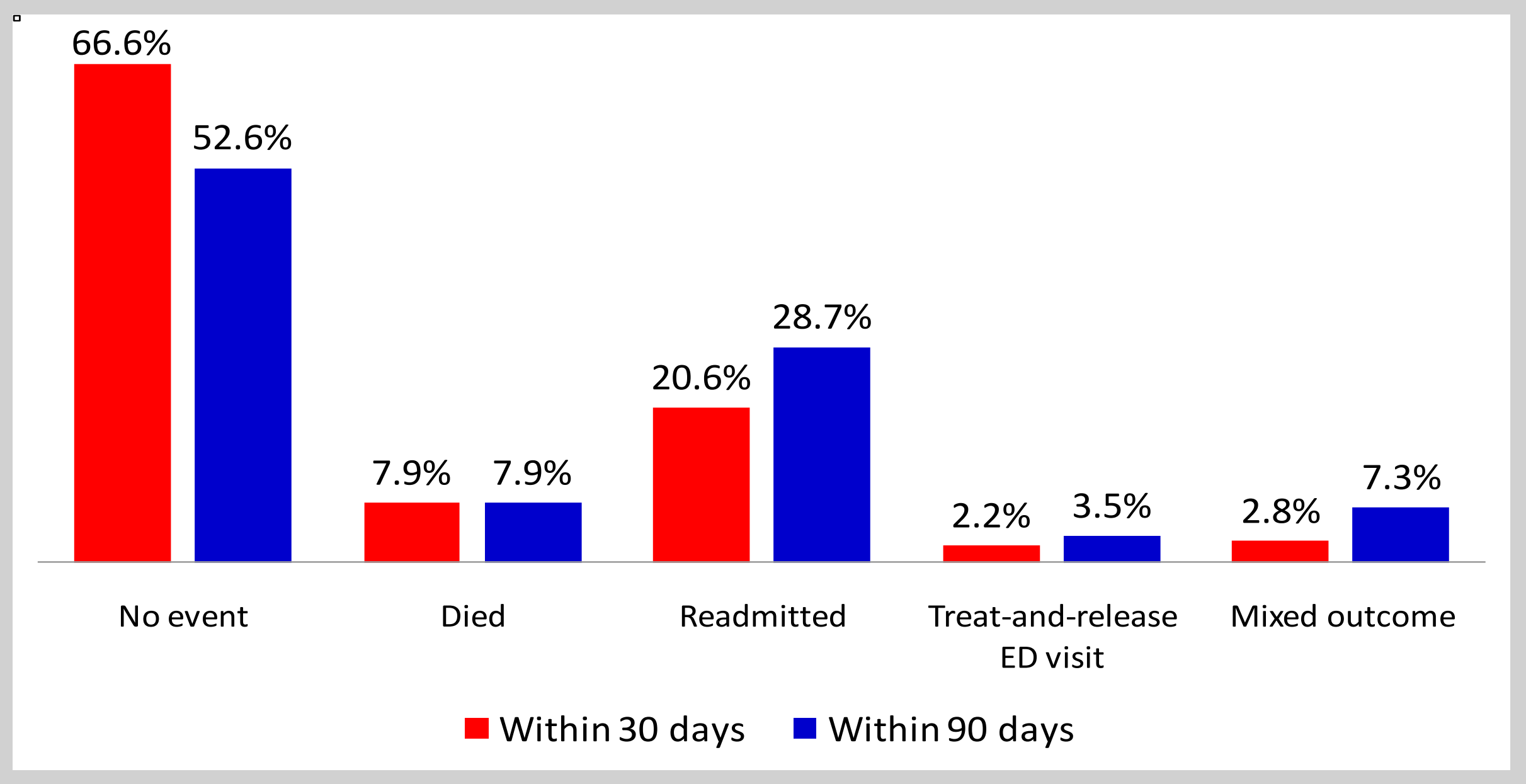
Study Methods: Data & Outcomes

- Model hospital readmission as a multinomial outcome
- Focus on Medicare patients in NJ with index admission for congestive heart failure (CHF), 2003–2009
- 5 multinomial outcomes within 30 days and 90 days
 1. No event
 2. Death
 3. Readmission
 4. Treat-and-release ED visit
 5. Mixed outcome

Study Methods: Model and Testing

- Multinomial logit
 - Standard errors adjusted for within hospital clustering
- Independent variables
 - Charlson comorbidity index
 - Age, sex, race/ethnicity
 - Length of stay (LOS) during index admission
 - Hospital fixed effects
- IIA assumption tested using series of Hausman tests
 - Sequential removal of alternative outcomes

Outcomes for Medicare Patients After Index Admission for CHF



Hausman tests for 30-day outcomes IIA assumption is almost always rejected

Outcome relative to no event	Outcome removed	p-value	IIA assumption
Readmission	Death	<0.001	Rejected
Readmission	ED visit	0.096	Rejected
Readmission	Mixed	0.023	Rejected
Death	Readmission	<0.001	Rejected
Death	ED visit	<0.001	Rejected
Death	Mixed	<0.001	Rejected
ED visit	Death	<0.001	Rejected
ED visit	Readmission	<0.001	Rejected
ED visit	Mixed	<0.001	Rejected

Discussion

- IIA assumption is routinely violated
- Binary models of CHF readmission and survival may be misspecified ==> inconsistent estimates
- Magnitude of inconsistency may be small
- IIA assumption not needed for multinomial probit models
 - Estimation is complex
 - Estimates did not converge
 - May not be possible in all applications
- Study focuses on Medicare CHF patients in NJ
 - Other populations/disease categories might be different

Hausman tests for 90-day outcomes IIA assumption is almost always rejected

Outcome relative to no event	Outcome removed	p-value	IIA assumption
Readmission	Death	<0.001	Rejected
Readmission	ED visit	0.723	Not rejected
Readmission	Mixed	<0.001	Rejected
Death	Readmission	<0.001	Rejected
Death	ED visit	<0.001	Rejected
Death	Mixed	<0.001	Rejected
ED visit	Death	<0.001	Rejected
ED visit	Readmission	<0.001	Rejected
ED visit	Mixed	<0.001	Rejected

Despite violation of IIA, coefficient estimates are stable. Example: 30-day readmission vs. no event

Variable	Coefficient from full model	Coefficient from model w/death excluded
Charlson index	.03224607***	.03177273***
Female	-.08520767***	-.08669764***
Age 75–84	-.02229777*	-.02396455*
Age > 84	-.13260441***	-.13897363***
NH black	-0.01978984	-0.01876753
Hispanic	0.02308196	0.02222806
Other/nonwhite	-.05986812***	-.0608138***
LOS: 4–6 days	.07878132***	.0797187***
LOS: 7–10 days	.2272596***	.22881316***
LOS: 11–17 days	.38165632***	.38332272***
LOS: 18–44 days	.59115775***	.59373837***
LOS: > 44 days	.94774188***	.94755158***
LOS: Unknown	.15478072***	.15586932***

Conclusions

- IIA theoretically a problem for evaluations that treat hospital readmission as a binary outcome
 - Magnitude of problem may be small
- Hospitals face new incentives under Medicare reimbursement regarding readmission
 - Old incentive: readmit marginal cases to earn revenue
 - New incentive: avoid readmitting marginal cases to avoid penalties
- Link between readmissions and ED visits may become stronger in the future
- Future analysis will need to consider IIA further