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Risk prediction models for contrast induced nephropathy: systematic review

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STUDY QUESTION

What validated clinical prediction models are available for contrast induced nephropathy, what are their characteristics, and how do they perform in clinical practice?

SUMMARY ANSWER

While higher performing models usually included pre-existing chronic kidney disease, age, diabetes, heart failure or impaired ejection fraction, and hypotension or shock, most published models have limited predictive ability in external populations and are only relevant to individuals undergoing coronary angiography.

WHAT IS KNOWN AND WHAT THIS PAPER ADDS

Contrast induced nephropathy is associated with significant morbidity and mortality; there are also several different models to predict its occurrence. This research demonstrates that current published models have limitations, and further work is needed to develop a model for contrast induced nephropathy that improves clinical decision making and patient outcomes.

Selection criteria for studies

We searched Medline, Embase, and CINAHL databases from inception to 2015, and performed hand searches of the retrieved reference lists. We conducted dual reviews to identify studies published in the English language of prediction models tested with patients that included derivation and validation cohorts. We extracted data on baseline patient characteristics, procedural characteristics, modeling methods, metrics of model performance, risk of bias, and clinical usefulness. Studies were eligible for inclusion if they evaluated the characteristics of a predictive model for identifying patients at risk of contrast induced nephropathy among adults undergoing a diagnostic or interventional procedure using conventional radiocontrast media (media used for computed tomography (CT) or angiography, and not gadolinium based contrast).

Primary outcome

Synthesis of the characteristics and performance of existing prediction models for contrast induced nephropathy.

Main results and role of chance

We identified 16 studies describing 12 prediction models. There was significant heterogeneity among the included studies, as a result of different clinical settings, cointerventions, and the timing of creatinine measurement to define contrast induced nephropathy. Discrimination varied in studies that were validated internally (C statistic 0.61-0.95) and externally (0.57-0.86). Only one study presented reclassification indices. The majority of higher performing models included measures of pre-existing chronic kidney disease, age, diabetes, heart failure or impaired ejection fraction, and hypotension or shock.

Bias, confounding, and other reasons for caution

Our included studies were heterogeneous in terms of their populations, administration of prophylactic therapies, and definitions of contrast induced nephropathy, which could have led to a differential risk for contrast induced nephropathy. Our review also focused only on trials where contrast was administered for a coronary procedure; therefore, the risk models reviewed might not be generalisable to other scenarios such as contrast enhanced CT studies, CT angiography and non-coronary angiography. Lastly, no model was prospectively evaluated in clinical practice to determine their effect on clinical decision making and patient outcomes.

Study funding/potential competing interests

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Characteristics of high performing prediction models for contrast induced nephropathy

Study, country	Study population	No of model predictors	C statistic		Online calculator available
			Derivation cohort	Validation cohort (and type of validation)	
Chen et al (2014), China	Percutaneous coronary intervention at one hospital	9	0.82	0.82 (internal, split sample)	No
Gurm et al (2013), United States	Percutaneous coronary intervention in multiple non-federal hospitals	15	Not reported	0.84 (internal, random forest)	Yes
Liu et al (2015), China	Percutaneous coronary intervention at one hospital	3	0.79	0.86 (internal, split sample)	No
Maioli et al (2010), Italy	Coronary angiography or percutaneous coronary intervention at one hospital	7	Not reported	0.82 (external, same centre as derivation cohort)	No

Mental illness, challenging behaviour, and psychotropic drug prescribing in people with intellectual disability: UK population based cohort study

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thebmj.com
- Editorial: Drug treatments in people with intellectual disability and challenging behaviour (*BMJ* 2014;349:g4323)
- Clinical review: Managing health problems in people with intellectual disabilities (*BMJ* 2008;337:a2507)

STUDY QUESTION

How does the incidence of mental illness and challenging behaviour in people with intellectual disability compare with the incidence of prescribing of psychotropic drugs in UK primary care, and what demographic factors and neuropsychiatric diagnoses are associated with prescribing of antipsychotics?

SUMMARY ANSWER

The incidence of prescription of psychotropic drugs far exceeds the incidence of recorded mental illness in people with intellectual disability, and new prescriptions of antipsychotics are independently associated with the presence of mental illness, challenging behaviour, autism, dementia, and advancing age.

WHAT IS KNOWN AND WHAT THIS PAPER ADDS

People with intellectual disability develop severe mental illness at higher rates than do the general population and may show challenging behaviour. Prescription of antipsychotic drugs in UK primary care is disproportionate to the level of recorded severe mental illness, and people with certain conditions are significantly more likely to receive antipsychotics despite lack of empirical support and contrary to guidelines of good clinical practice.

Participants and setting

Data came from 571 general practices contributing to The Health Improvement Network, a large UK primary care research database. We included 33 016 adults with intellectual disability.

Design, size, and duration

We measured existing (recorded before cohort entry) and new (recorded during follow-up) recording of mental illness, challenging behaviour, and prescription of psychotropic drugs by drug class, between January 1999 and December 2013. Participants contributed a total of 211 793 person years of data, and median follow-up time was 5.5 years.

Associations of new antipsychotic drug prescribing with neuropsychiatric diagnoses in adults with intellectual disability in UK primary care

Neuropsychiatric diagnosis	Incidence rate ratio* (95% CI)	P value
Severe mental illness	6.69 (5.83 to 7.68)	<0.001
Challenging behaviour	2.08 (1.90 to 2.27)	<0.001
Autism	1.79 (1.56 to 2.04)	<0.001
Depression	1.79 (1.62 to 1.98)	<0.001
Anxiety	1.63 (1.47 to 1.81)	<0.001
Dementia	1.42 (1.12 to 1.81)	0.003
Epilepsy	1.15 (1.04 to 1.28)	0.007

*Adjusted for age, sex, social deprivation, time period, and neuropsychiatric diagnoses.

Main results and the role of chance

Twenty one per cent of the cohort had a record of mental illness at study entry, 25% (8300) had a record of challenging behaviour, and 49% (16 242) had a record of prescription of psychotropics. The incidence of newly recorded mental illness was 262 (95% confidence interval 254 to 271) per 10 000 person years and that of newly recorded challenging behaviour was 239 (231 to 247) per 10 000 person years. The incidence of new prescription of psychotropic drugs was 518 (503 to 533) per 10 000 person years. New recording of severe mental illness declined by 5% per year, and new prescriptions of antipsychotics fell by 4% over the course of the study period. Overall, 71% (6503/9135) of people treated with antipsychotic drugs did not have a recorded diagnosis of severe mental illness. The table shows neuropsychiatric diagnoses associated with new prescribing of antipsychotics.

Bias, confounding, and other reasons for caution

Results of the multivariable regression are adjusted for age, sex, social deprivation, time period, and neuropsychiatric diagnoses. Rates of mental illness and challenging behaviour derived from primary healthcare records may potentially underestimate the true rate of morbidity, and the method we used to identify cases of challenging behaviour has not been externally validated.

Generalisability to other populations

The Health Improvement Network clinical database is representative of the UK population, and our method identified most people with known intellectual disability in the database. Results are therefore likely to be generalisable across the United Kingdom. Findings may not be generalisable to people with undiagnosed mild intellectual disability or those living in other countries, particularly if standard living arrangements and health provision for people with intellectual disability vary from those in the United Kingdom.

Study funding/potential competing interests

This study received funding from the Baily Thomas Charitable Fund and the UK National Institute for Health Research. AS has received research grants from the Wellcome Trust and acted as an investigator for Roche Pharmaceuticals.

Access, quality, and costs of care at physician owned hospitals in the United States: observational study

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STUDY QUESTION

How do US physician owned hospitals (POHs) and non-POHs compare to each other in terms of their patient populations, quality of care, and costs of care?

SUMMARY ANSWER

Although POHs may treat slightly healthier patients, POHs and non-POHs performed similarly on patient experience scores, processes of care, risk adjusted 30 day mortality, 30 day readmission rates, costs, and payments for acute myocardial infarction, congestive heart failure, and pneumonia.

WHAT IS KNOWN AND WHAT THIS PAPER ADDS

Previous research has found that specialty POHs treat healthier patients, avoid patients with Medicaid and those from ethnic minority groups, and increase service utilization through self referrals. Based in part on this evidence, policy makers added provisions to the Patient Protection and Affordable Care Act of 2010, which severely restrict the growth of all POHs, including both general and specialty POHs. We found that POHs may treat slightly healthier patients, but do not systematically avoid patients with Medicaid and those from ethnic minority groups, and that overall costs of care, payments for care, and quality of care are similar between POHs and non-POHs.

Patient characteristics and quality and cost of care at physician owned hospitals (POHs) and non-POHs. Values are percentages unless stated otherwise

Outcomes	POHs (n=219)	Non-POHs (n=1967)	Difference (95% CI)	P value
Mean No of Elixhauser comorbidities*	1.6	1.8	—	<0.001
Median (interquartile range) No of Elixhauser comorbidities	1.0 (1.0-2.0)	1.0 (2.0-3.0)	—	
Mean predicted mortality†	7.2	7.5	—	0.36
Median (interquartile range) predicted mortality	9.6 (5.9-11.0)	10.1 (7.6-11.7)	—	
Patient experience	74.3	74.9	−0.6 (−2.3 to 1.1)	0.49
Process measures:				
Overall†	92.2	92.3	−0.2 (−1.5 to 1.2)	0.81
Acute myocardial infarction	92.8	93.7	−1.0 (−2.2 to 0.3)	0.12
Congestive heart failure	86.5	87.9	−1.4 (−3.8 to 1.0)	0.26
Pneumonia	88.9	89.4	−0.5 (−2.3 to 1.2)	0.57
Risk adjusted hospital mortality:				
Overall	13.9	13.9	0.1 (−1.0 to 1.1)	0.91
Acute myocardial infarction*	17.7	18.9	−1.2 (−3.7 to 1.3)	0.36
Congestive heart failure*	12.7	12.7	0.0 (−1.1 to 1.2)	0.95
Pneumonia*	8.8	8.7	0.1 (−1.1 to 1.1)	0.97
Hospital cost and utilization				
Risk adjusted readmission‡	26.0	25.5	0.5 (−0.5 to 1.5)	0.31
Risk adjusted cost ($)§	10 113	10 024	88 (−692 to 869)	0.82
Payment ($)¶	7217	7033	183 (−375 to 741)	0.52

$1.00 (£0.60; €0.90).
All analyses are weighted and adjusted for hospital structural characteristics (see table 1 in full version on bmj.com) and for hospital referral region.
†Composite of process measures for acute myocardial infarction, congestive heart failure, and pneumonia.
*Data from 2009-10. All other data from 2010.
‡Indirect standardized composite measure for acute myocardial infarction, congestive heart failure, and pneumonia.
§Indirect standardized composite measure for hospital costs for acute myocardial infarction, congestive heart failure, and pneumonia.
¶Indirect standardized composite measure for Medicare payments for acute myocardial infarction, congestive heart failure, and pneumonia.

Participants and setting

We used 2010 data on 219 POHs in 95 hospital referral regions and 1967 non-POHs in these hospital referral regions.

Design, size, and duration

To identify POHs, we used a nearly comprehensive list of existing medical and surgical POHs in the United States made available by the Physician Hospitals of America. We linked these data to American Hospital Association survey data, inpatient Medicare claims data, and data on hospital quality performance from Medicare Hospital Compare.

Main results

The 219 POHs were more often small (<100 beds), for profit, and in urban areas. 120 of these POHs were general (non-specialty) hospitals. Compared with patients from non-POHs, those from POHs were younger (77.4 *v* 78.4 years, P<0.001), less likely to be admitted through an emergency department (44 170 (23.2%) *v*. 921 392 (29.0%), P<0.001), equally likely to be black (9710 (5.1%) *v* 489 291 (5.5%), P=0.85) or to use Medicaid (28 368 (14.9%) *v* 489 291 (15.4%), P=0.75), and had similar numbers of chronic diseases and predicted mortality scores. POHs and non-POHs performed similarly on patient experience scores, processes of care, risk adjusted 30 day mortality, 30 day readmission rates, costs, and payments for acute myocardial infarction, congestive heart failure, and pneumonia.

Bias, confounding, and other reasons for caution

Although we examined sources of patient admissions at POHs and other hospitals, we did not directly investigate referral patterns by physician owners of POHs. Moreover, we did not evaluate long term total costs for episodes of care, which may vary more between POHs and non-POHs than do costs for single episodes of care. We also did not examine outcomes for major procedures, such as coronary artery bypass graft or joint replacement surgeries, which are performed routinely at some specialty POHs. Finally, our results, as with those of all observational studies, are subject to confounding by unmeasured variables. While we tried our best to identify and account for potential confounders, any such effort is inherently imperfect.

Generalisability to other populations

Our findings may not extend to patients without Medicare or to care for other illnesses.

Study funding/potential competing interests

This study was funded using internal resources from the Department of Health Policy and Management at the T H Chan School of Public Health at Harvard University. We have no competing interests.