PREDICTING PSYCHIATRIC READMISSION:
SEX-SPECIFIC MODELS TO PREDICT 30-DAY READMISSION FOLLOWING ACUTE PSYCHIATRIC HOSPITALIZATION

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Disclosures

- I have no financial disclosures or conflicts of interest relevant to this project

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Overview

- **The issue:** Readmission to hospital following psychiatric hospitalization is a common negative outcome. Women and men have similar risk for readmission, but risk factors may differ by gender.

- **What this study accomplished:** Learned that while most risk factors for readmission are similar between males and females, certain risk factors differ by gender.

- **How we got there:** Split-sample cohort study using Ontario health administrative data to derive and validate separate models of readmission risk for each gender.

Rationale

- Readmission following psychiatric hospitalization is common, with 10-15% of discharged patients returning in the first 30 days

- Readmission is a negative outcome (clinical, systems-level)

- Risk factors for readmission have been well-studied in the general literature, but readmission continues to be common

Canadian Institute for Health Information, *Health Indicators 2011* (Ottawa, Ont.: CIHI, 2011).
Heslin, K., Weiss, A.J. (2015). Hospital Readmissions Involving Psychiatric Disorders, 2012. HCUP Statistical Brief #189.
OECD (2013), "Unplanned hospital re-admissions for patients with mental disorders", in *Health at a Glance 2013: OECD Indicators,* OECD Publishing.
Vigod, S. N., et al. (2015). "READMIT: a clinical risk index to predict 30-day readmission after discharge from acute psychiatric units." J Psychiatr Res **61**: 205-213

Rationale

- Sociodemographic and clinical profiles of men and women with mental illness are different in some important ways

- Men and women have similar readmission rates, however one small single-center study suggests that some risk factors for readmission differ by gender - this has not yet been studied on a population level

- A better understanding of readmission risk by gender may help prevent readmission

Vigod SN, Kurdyak P, Fung K, Gruneir A, Herrmann N, Hussain-Shamsy N, Isen M, Lin E, Rochon PA, Taylor VH, and Seitz DP. (2016 in press). Psychiatric Services Men and women hospitalized for acute psychiatric care: comparing socio-demographics, clinical characteristics and post-discharge outcomes.
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Our Research Goal

To derive and validate sex-specific clinically relevant models to predict readmission following psychiatric hospital admission.

Methods

- **Study Design:** Split-sample cohort study using Ontario population-based health administrative data to derive and validate sex-specific predictive models of readmission

- **Sample:** Males and females discharged from acute psychiatric units in Ontario, Canada between 2008 and 2011

- **Primary outcome:** Readmission to hospital for a psychiatric reason within 30 days

- **Comparisons:** For males and female separately, we compared readmissions and nonreadmission on sociodemographic information, health service use history, and clinical variables related to index admission

Data Sources

- Ontario health administrative data sources at the Institute for Clinical Evaluative Sciences (ICES)
    - Patient level records anonymously linked through a unique identifier for every Ontario resident with a health care number.
  - Sources:
    - Registered Persons Database *(RPDB)*
      Ontario Mental Health Reporting System (*OMHRS*)
      - Includes RAI-MH
    - Canadian Institutes of Health Information Discharge Abstract Database (*CIHI-DAD*)
    - Ontario Health Insurance Plan (*OHIP*)
    - National Ambulatory Care Reporting System (*NACRS*).

RAI-MH

- **Resident Assessment Instrument – Mental Health (RAI-MH)**
  - Completed by clinical staff within 3 days, every 90 days, and at again discharge for all psychiatric inpatients
  - Includes:
    - Demographic and socioeconomic information
    - Diagnosis (DSM-IV)
    - Clinical scales including:
      - Psychiatric symptoms
      - Substance use
      - Cognition
      - Functional impairment
      - Aggressive behaviour
      - Medication adherence

Hirdes, J. P., et al. (2000). "Development of the Resident Assessment Instrument--Mental Health (RAI-MH)." Hosp Q **4**(2): 44-51

Statistical Analysis

- Steps:
    1. For separate male and female cohorts, we described those who were readmitted and not readmitted using means and/or proportions

    2. Randomly divided each cohort (male and female) into "derivation" and "validation" samples

    3. Sequential derivation of the multivariable models (next slide)

    1. Validation of the models
        - Odds ratios and 95% confidence intervals for individual variables
        - Hosmer-Lemeshow goodness-of-fit test and c-statistics (with 95% confidence intervals) to determine overall model fit and discrimination

Multivariable model derivation

- Using multivariable logistic regression models, we sequentially added possible predictor variables
  - Predictors added in 4 steps

- Each variable (or group of variables) was either included or excluded based on its ability to improve predictive power compared to the previous (simpler) model

- Hosmer-Lemeshow goodness-of-fit test and c-statistics were used to determine overall model fit and discrimination, respectively

Results

- There were 33,353 female index admissions and 32,436 male index admissions to psychiatric units during the three-year study period

- Risk of readmission was 9.08% for females (n=3,030) and 9.29% for males (n=3,014)

Variable	Female			Male		
	No readmission in 30 days	Readmission in 30 days	Total	No readmission in 30 days	Readmission in 30 days	Total
	N=30,323	N=3,030	N=33,353	N=29,422	N=3,014	N=32,436
Age in years, Median (IQR)	46 (34-57)	43 (30-54)	46 (33-57)	42 (29-53)	39 (26-51)	42 (29-53)
Married / common-law partner	9,875 (32.6)	823 (27.2)	10,698 (32.1)	7,551 (25.7)	582 (19.3)	8,133 (25.1)
Education level <=11th grade	6591 (21.7)	741 (24.5)	7,332 (22.0)	7836 (26.6)	861 (28.6)	8,697 (26.8)
Lowest neighbourhood income quintile	8,715 (28.7)	970 (32.0)	9,685 (29.0)	8,325 (28.3)	923 (30.6)	9,248 (28.5)
Rural residence (population < 10,000)	3,274 (10.8)	310 (10.2)	3,584 (10.7)	3,324 (11.3)	316 (10.5)	3,640 (11.2)
Life stressors 3+	17,974 (59.3)	1,734 (57.2)	19,708 (59.1)	15,437 (52.5)	1,460 (48.4)	16,897 (52.1)

Table 1a (partial). . Selected sociodemographic characteristics from the index admission of 33,353 females and 32,436 males discharged from an acute psychiatric unit in Ontario between 2008 and 2011, by 30-day readmission status. Presented as n(%) unless otherwise specified.

Variable	Female			Male		
	No readmission in 30 days	Readmission in 30 days	Total	No readmission in 30 days	Readmission in 30 days	Total
	N=30,323	N=3,030	N=33,353	N=29,422	N=3,014	N=32,436
No. of prior psychiatric admissions 6+	3,185 (10.5)	531 (17.5)	3,716 (11.1)	2,578 (8.8)	460 (15.3)	3,038 (9.4)
Psychiatric ED visits in past year >=1	6,985 (23.0)	930 (30.7)	7,915 (23.7)	6,652 (22.6)	922 (30.6)	7,574 (23.4)
Mental health MD outpatient visits in past year	24,461 (80.7)	2,503 (82.6)	26,964 (80.8)	21,553 (73.2)	2,334 (77.4)	23,887 (73.6)
Contact with community mental health in the past year	15,279 (50.4)	1,754 (57.9)	17,033 (51.1)	13,647 (46.4)	1,595 (52.9)	15,242 (47.0)
Charlson Score 3+ in past 2 years	867 (2.9)	73 (2.4)	940 (2.8)	880 (3.0)	91 (3.0)	971 (3.0)

Table 1b (partial). Selected health service use characteristics from the index admission of 33,353 females and 32,436 males discharged from an acute psychiatric unit in Ontario between 2008 and 2011, by 30-day readmission status. Presented as n(%) unless otherwise specified.
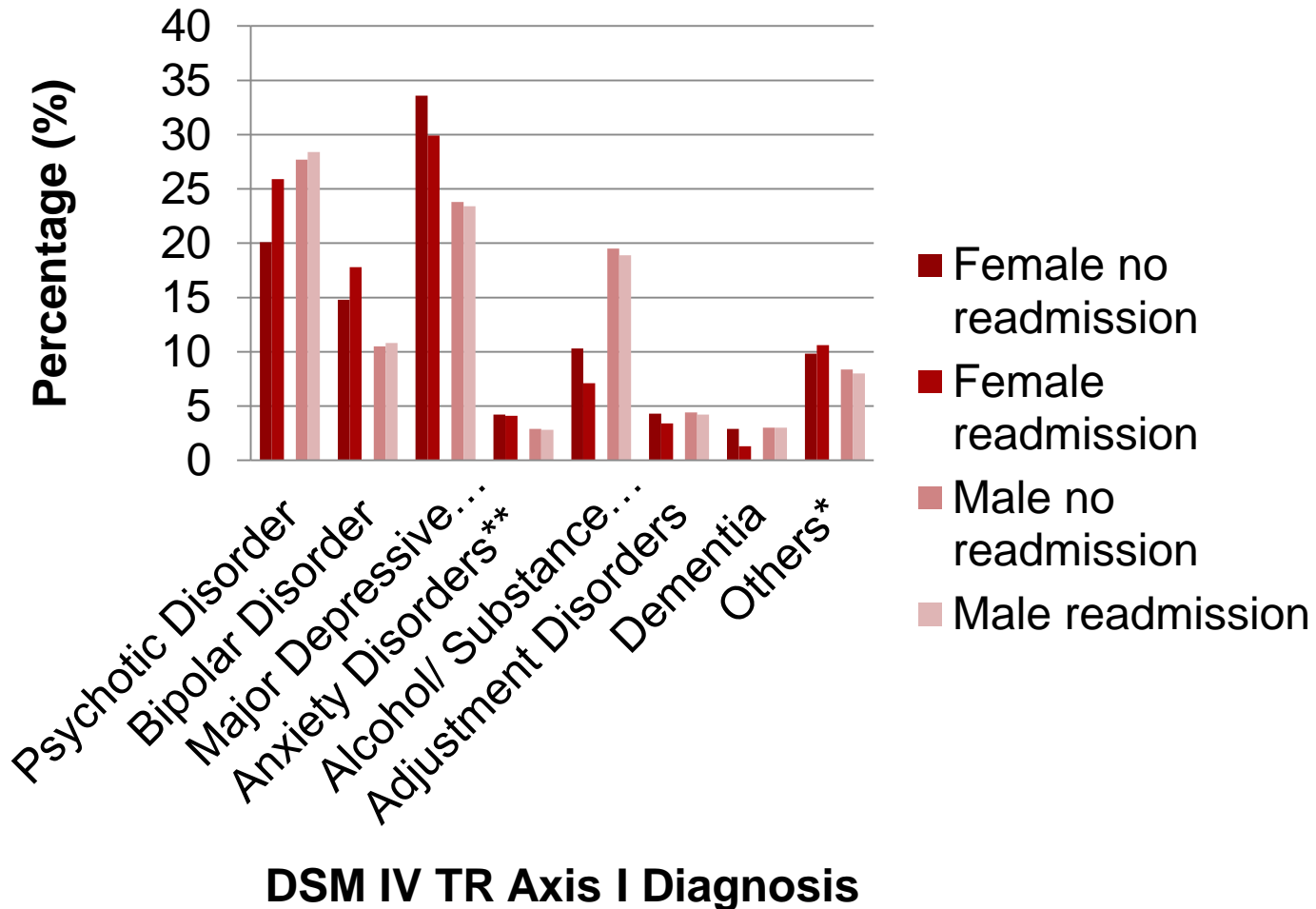
Figure 1. DSM IV TR Axis I admission diagnoses from the index admission of 33,353 females and 32,436 males discharged from an acute psychiatric unit in Ontario between 2008 and 2011, by 30-day readmission status.
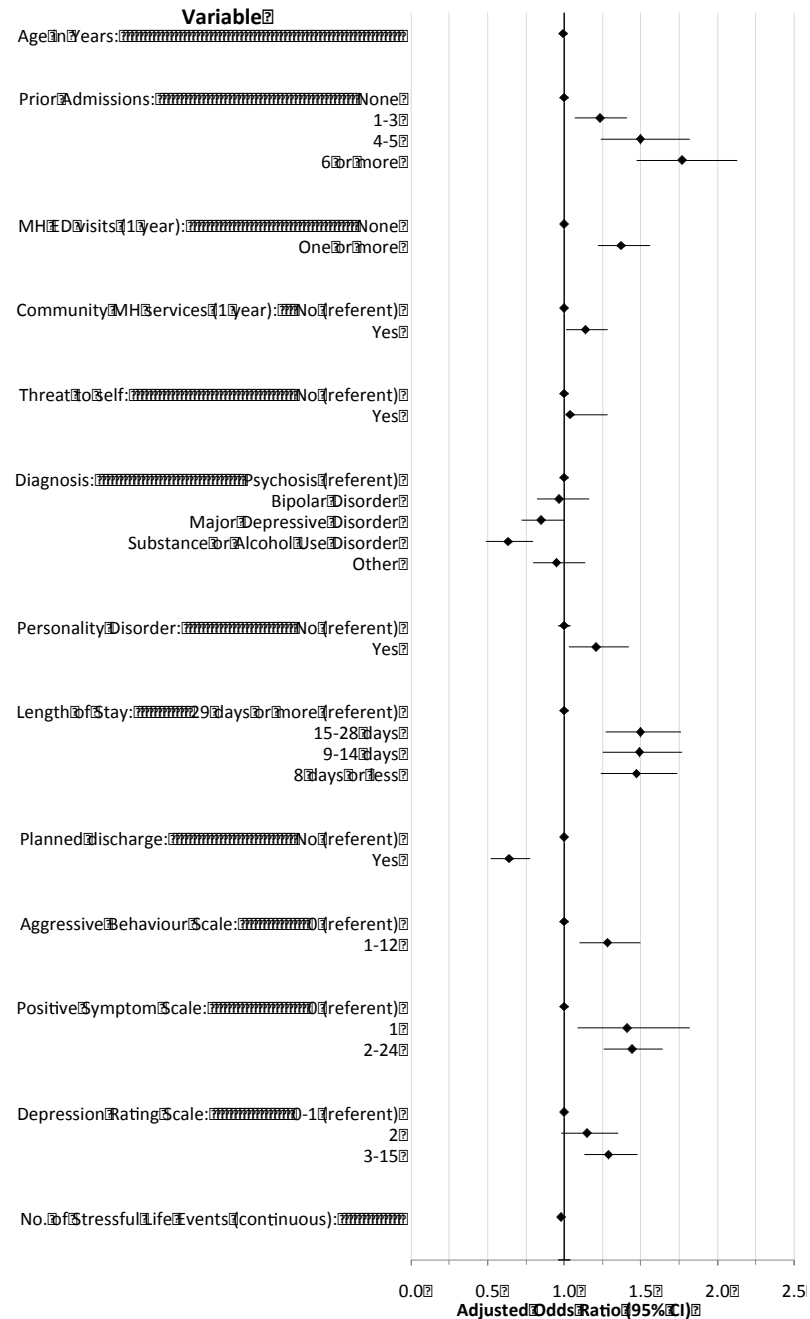
MODEL:
Female

Figure 2. Predictive model of 30-day psychiatric readmission risk for females created using the derivation cohort (n=16,677).
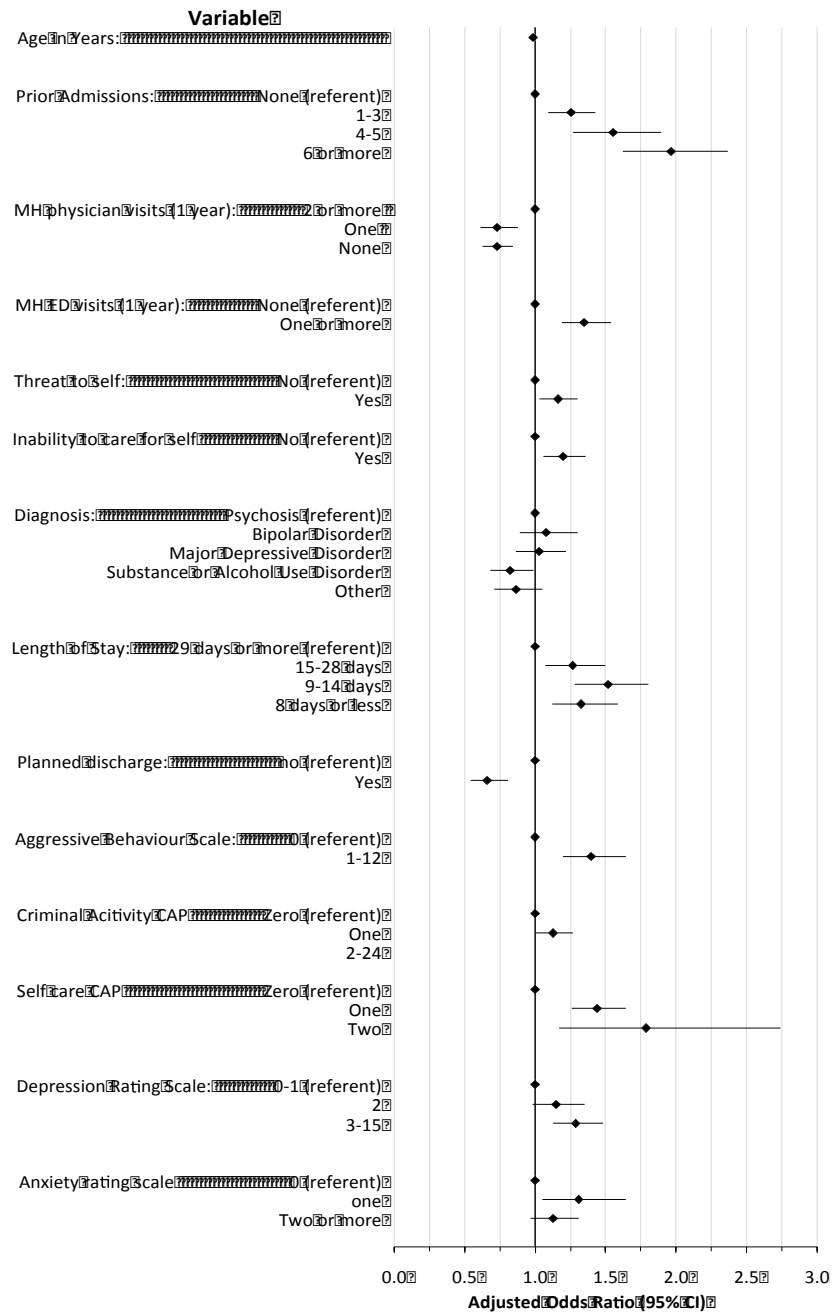
MODEL:
Male

Figure 3. Predictive model of 30-day psychiatric readmission risk for males created using the derivation cohort (n=16,218).

Model Validation

- Females:
  - Derivation: c-statistic 0.645, HL Goodness-of-fit 0.3781
  - Validation: c-statistic 0.652, HL Goodness-of-fit 0.6751
- Males
  - Derivation: c-statistic 0.658, HL Goodness-of-fit 0.0289
  - Validation: c-statistic 0.653, HL Goodness-of-fit 0.5371

Risk Factors in Context

MALE AND FEMALE
+++Number of previous psychiatric admissions
+++Short admission
++Previous psychiatric ED visits
++Outpatient mental health services
++Unplanned discharge
+Threat to self at admission
+ Young age
+Aggressive behaviour
+Depressive symptoms
--Primary diagnosis substance use disorder

FEMALE
++Positive symptoms
+Personality disorder
+Lower number of life events
-Depression (vs psychosis)

MALE
+++Poor self-care
+Criminal activity

Strengths and Limitations

- Strengths
  - Population-level coverage
  - Readmission to all hospitals (not just index hospital)
  - Multiple demographic and clinical variables
  - Model derived AND validated
- Limitations
  - Limited information on discharge plans/adherence to plans
  - Binary gender definition
  - Relevant to admissions longer than 3 days

Implications and Next Steps

- While most risk factors for readmission are consistent across gender, specific risk factors for readmission differ. Understanding these gender differences could help prevent readmission by:
  - Targeting clinical interventions at the individual level.
  - Informing policy at the systems level.

- Future research on possible interventions to reduce readmissions for men and women is necessary so that prediction of readmission risk can be accompanied by appropriate interventions.

Thank you

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