# Association of emergency department boarding times on hospital length of stay for patients with psychiatric illness

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## ABSTRACT

**Background** Extended periods awaiting an inpatient bed in the emergency department (ED) may exacerbate the state of patients with acute psychiatric illness, increasing the time it takes to stabilise their acute problem in hospital. Therefore, we assessed the association between boarding time and hospital length of stay for psychiatric patients.

**Methods** ED clinical records were linked to inpatient administrative records for all patients with a primary psychiatric diagnosis admitted to a Calgary, Alberta hospital between April 2014 and March 2018. The primary exposure was boarding time (admission decision to inpatient bed transfer), and primary outcome was inpatient length of stay. Confounders for this relationship, including indicators of illness severity, were selected a priori then the association was assessed using hierarchical Bayesian Poisson regression, which accounts for repeat observations of the same patient and differences between hospital sites. Changes in length of stay were measured using a rate ratio (ie, expected change in length of stay for each 1 hour increase in boarding time).

**Results** A total of 19 212 admissions (14 261 unique patients) were included in the analysis. The average boarding time was 14 hours (range: 0–186 hours). Patients who were boarded for greater than 14 hours more frequently required a high-observation bed (14% vs 3.5%), received an antipsychotic (44% vs 14%) or received sedation (55% vs 33%) while in the ED. The probability that boarding time increased hospital length of stay (rate ratio: >1) was 92%, with a median increase for a patient boarded for 24 hours of 0.01 days.

**Conclusion** Boarding in the ED was associated with a high probability of increasing the hospital length of stay for psychiatric patients; however, the absolute increase is minimal. Although slight, this signal for longer length of stay may be a sign of increased morbidity for psychiatric patients held in the ED.

## Key messages

**What is already known on this subject**

⇒ Patients with acute psychiatric illness are commonly admitted to the hospital through the emergency department (ED) but may be boarded for extended periods of time before being admitted. Extended boarding times may exacerbate the psychiatric state of these vulnerable patients, resulting in a longer hospitalisation to treat their acute needs.

**What this study adds?**

⇒ In this large cohort study, boarding in the ED was associated with a high probability of increased hospital length of stay for psychiatric patients; however, the absolute increase is minimal. Efforts to minimise boarding time for patients with acute psychiatric illness should be considered.

## INTRODUCTION

The emergency department (ED) is the initial site of evaluation for many patients experiencing acute mental health concerns. Psychiatric patients account for an estimated 4% of all patients accessing the ED[1]; however, they often wait longer for admission than non-psychiatric patients.[2–4] This extended period waiting in the ED after an admission decision has been made, known in the literature as boarding time, may exacerbate the psychiatric state of these vulnerable patients,[5] resulting in a longer hospitalisation to treat their acute needs.

Knowledge of the impact that extended boarding times have on a psychiatric patient may be critical for policy decision making, but no randomised trial can be ethically conducted to assess the causal effect of a system-access exposure such as boarding time. Several descriptive studies have identified factors associated with increased boarding time in the ED, including the specific psychiatric diagnosis,[6 7] use of physical or chemical restraints,[8 9] and the day/time a patient access the ED.[6 10–12] Therefore, utilising knowledge from these prior studies, we hypothesised a potential causal relationship, including known confounders, then assessed the association between boarding time and hospital length of stay for psychiatric patients.

## METHODS
### Design/setting

ED clinical records were linked retrospectively to inpatient records for all patients admitted to hospital with a primary psychiatric diagnosis between April 2014 and March 2018 in Calgary, Alberta, Canada. All hospitals included in this study have general adult EDs with the capacity to admit psychiatric patients to inpatient units. A model for the relationship of interest and significant confounders was
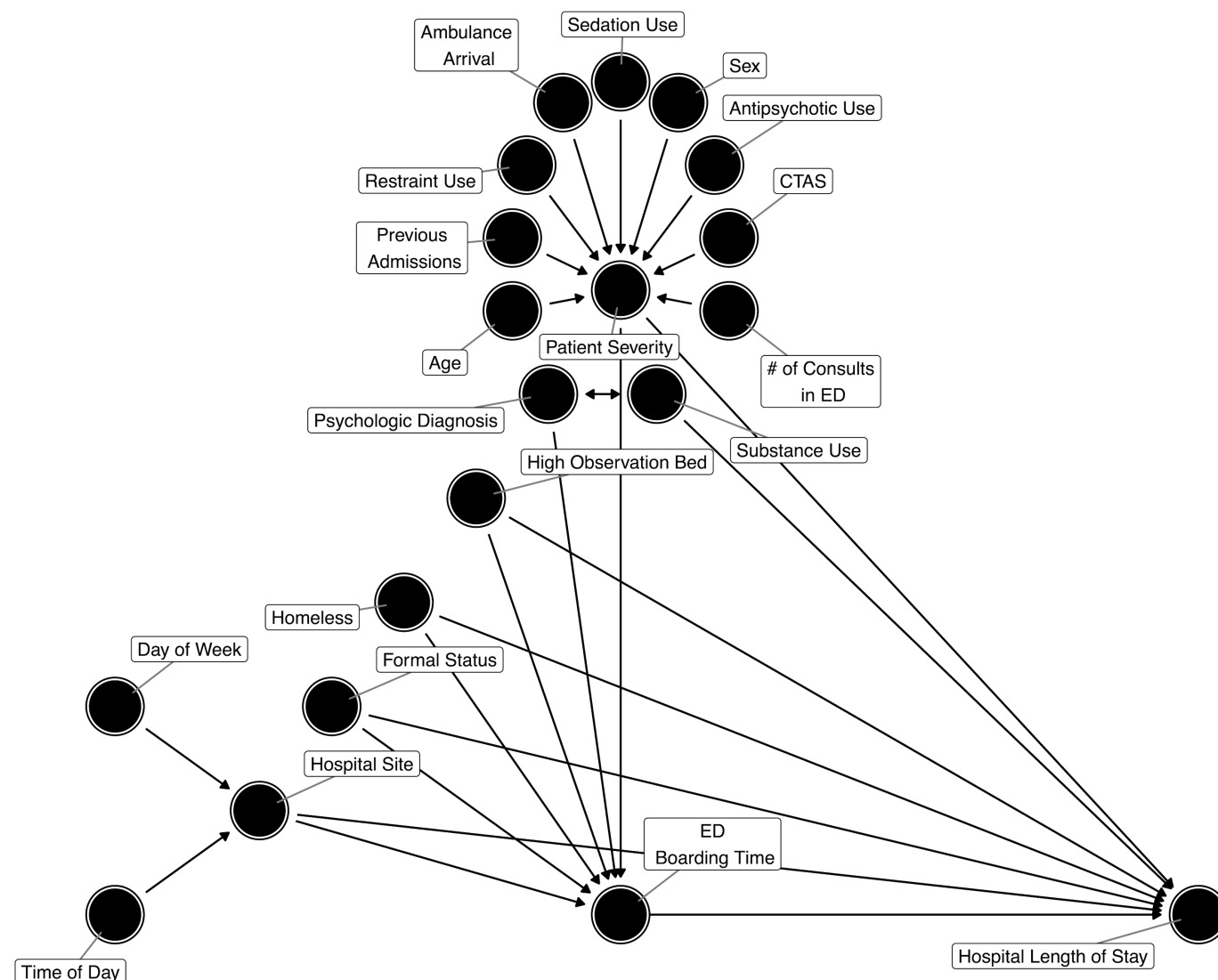
**Figure 1** Directed acyclic graph model for the effect of boarding time on hospital length of stay. Note: patient severity is an unmeasurable construct and, therefore, we used the variables indicated to approximate the patient's severity while in the ED. CTAS, Canadian Triage Acuity Scale; ED, emergency department.

developed a priori through consultation between senior ED and psychiatry physicians and is presented in figure 1.

## Participants

Psychiatric diagnosis was identified by examining the most responsible diagnosis field (ie, first diagnosis code listed) in the Discharge Abstract Database for International Classification of Disease Tenth edition (ICD-10CA) codes beginning with F, which represent psychiatric diagnoses.[13] All adult patients with a most responsible diagnosis consistent with a psychiatric disorder admitted to hospital during the study period were linked to their hospital records. Inpatient diagnosis was used instead of ED diagnosis, as it was hypothesised that this would be more accurate as patients would have more time to be thoroughly assessed by psychiatric specialists and would be unlikely to have a new psychiatric illness evolve during the course of the hospital stay. These diagnoses were classified into 15 unique categories as is described in online supplemental Table 1.

## Measures

The primary outcome of interest was hospital length of stay, defined by a count of calendar days where a patient remained

admitted to the hospital. The primary exposure was boarding time, defined as a continuous measure based on the difference between the admission request by the consulting psychiatrist and the actual time a patient leaves the ED for the ward. Confounders for the association of interest were identified from the ED record and are presented in figure 1: (1) ED wait time (defined as the time from arrival to the time of initial assessment by an ED physician) and ED decision time (defined as the time from initial assessment by an ED physician to the time an admission order was placed) were included as continuous measures; (2) Mental Health Act (MHA) detention, patients who meet criteria for certification under the provincial MHA and will be admitted to the hospital involuntarily, was determined from the extracted triage or nursing note of the same; (3) the number of previous admissions were entered as a count representing the number of times each individual patient had been admitted in the previous 1-year period; (4) the use of physical restraints, chemical sedation/hypnotics (eg, lorazepam) or antipsychotic medication (eg, haloperidol) in the ED was identified in ED care record; (5) requests for a high-observation bed on the inpatient unit (locking secure rooms for the purposes of acute containment of agitation or other risky behaviours,

**Table 1**  Characteristics of study patients

| | Overall | Boarding <14 hours | Boarding ≥14 hours | SMD for boarding |
|---|---|---|---|---|
| n | 22 447 | 14 357 | 8 029 | |
| **Patient characteristics** | | | | |
| Age (years) (IQR) | 47 (32, 65) | 49 (33, 66) | 45 (30, 63) | 0.117 |
| Male sex (%) | 12 127 (54) | 7688 (54) | 4406 (55) | 0.027 |
| Admissions in previous year (%) | 0.0 (0.0, 0.0) | 0.0 (0.0, 0.0) | 0.0 (0.0, 0.0) | 0.037 |
| No fixed address (%) | 1688 (7.5) | 1017 (7.1) | 666 (8.3) | 0.045 |
| Family MD (%) | 14 672 (83.4) | 9422 (84.1) | 5206 (82.2) | 0.052 |
| **Primary psychiatric diagnosis** | | | | 0.176 |
| Anxiety (%) | 446 (2.0) | 321 (2.2) | 124 (1.5) | |
| Bipolar (%) | 1251 (5.6) | 744 (5.2) | 505 (6.3) | |
| Conduct (%) | 103 (0.5) | 58 (0.4) | 45 (0.6) | |
| Depression (%) | 2176 (9.7) | 1500 (10.4) | 671 (8.4) | |
| Dissociative (%) | 109 (0.5) | 71 (0.5) | 38 (0.5) | |
| Eating (%) | 73 (0.3) | 57 (0.4) | 16 (0.2) | |
| Neurocognitive (%) | 4222 (18.8) | 2783 (19.4) | 1434 (17.9) | |
| Neurodevelopmental (%) | 132 (0.6) | 67 (0.5) | 65 (0.8) | |
| Obsessive (%) | 68 (0.3) | 45 (0.3) | 23 (0.3) | |
| Other (%) | 159 (0.7) | 99 (0.7) | 59 (0.7) | |
| Personality (%) | 608 (2.7) | 350 (2.4) | 250 (3.1) | |
| Psychosis (%) | 3803 (16.9) | 2296 (16.0) | 1491 (18.6) | |
| Somatic (%) | 85 (0.4) | 54 (0.4) | 31 (0.4) | |
| Substance (%) | 6614 (29.5) | 4406 (30.7) | 2198 (27.4) | |
| Trauma (%) | 2594 (11.6) | 1505 (10.5) | 1076 (13.4) | |
| Secondary substance use (%) | 5428 (24.2) | 3311 (23.1) | 2103 (26.2) | 0.073 |
| Alcohol (%)* | 6049 (26.9) | 4123 (28.7) | 1916 (23.9) | 0.110 |
| Opioids (%)* | 672 (3.0) | 395 (2.8) | 276 (3.4) | 0.040 |
| Cannabinoids (%)* | 1549 (6.9) | 849 (5.9) | 693 (8.6) | 0.105 |
| Sedatives (%)* | 254 (1.1) | 174 (1.2) | 79 (1.0) | 0.022 |
| Cocaine (%)* | 718 (3.2) | 413 (2.9) | 305 (3.8) | 0.051 |
| Stimulant (%)* | 1152 (5.1) | 595 (4.1) | 555 (6.9) | 0.121 |
| Hallucinogen (%)* | 35 (0.2) | 23 (0.2) | 12 (0.1) | 0.003 |
| **Demographic characteristics** | | | | |
| Arrival means | | | | 0.136 |
| No ambulance (%) | 11 185 (49.8) | 7065 (49.2) | 4092 (51.0) | |
| Air ambulance (%) | 21 (0.1) | 14 (0.1) | 7 (0.1) | |
| Ground ambulance (%) | 10 385 (46.3) | 6853 (47.7) | 3499 (43.6) | |
| Police (%) | 856 (3.8) | 425 (3.0) | 431 (5.4) | |
| **ED** | | | | |
| CTAS score (IQR) | 2 (2,3) | 2 (2,3) | 2 (2,3) | 0.038 |
| Antipsychotic used (%) | 5431 (24.2) | 1940 (13.5) | 3490 (43.5) | 0.704 |
| Sedative used (%) | 9188 (40.9) | 4799 (33.4) | 4383 (54.6) | 0.436 |
| Restraints used (%) | 3577 (15.9) | 2091 (14.6) | 1477 (18.4) | 0.103 |
| Mental health form (%) | 6254 (27.9) | 3408 (23.7) | 2812 (35.0) | 0.250 |
| High observation bed (%) | 1607 (7.2) | 496 (3.5) | 1111 (13.8) | 0.376 |
| MD assessment to admit (hours) (IQR) | 5.2 (3.5, 7.9) | 5.2 (3.5, 8.0) | 5.2 (3.5, 7.7) | 0.019 |
| Boarding time (hours) (IQR) | 6.5 (1.9, 18.8) | 2.5 (1.4, 5.9) | 23 (18, 38) | 1.887 |
| Total ED time (hours) (IQR) | 16.9 (8.6, 26.4) | 10.2 (6.8, 16.2) | 31 (25, 46) | 1.787 |
| **Primary outcome** | | | | |
| Hospital length of stay (days) (IQR) | 8.4 (3.5, 25) | 8.6 (3.5, 25) | 8.1 (3.8, 26) | 0.025 |

SMD comparing differences between ≥14 hours and <14 hours boarding time.
*Primary or secondary substance use disorders
CTAS, Canadian Triage Acuity Scale, 1 is most urgent; 5 is least urgent; ED, emergency department; SMD, standardised mean difference.

which represent 10% of inpatient beds) were identified in the admission orders from the ED and (6) secondary substance use was identified from the same inpatient diagnosis codes as the primary diagnosis, and was defined based on the presence of one ICD-10CA code for substance use (F09–F19) in any of the secondary diagnosis fields.

## Analysis

Descriptive statistics with standardised mean differences were used to compare two groups stratified at the mean boarding time. Although boarding time is right-skewed, we elected to stratify the group by the mean for this descriptive analysis as it was selected for a group with more extreme boarding time (≥14

hours) and less extreme boarding time (<14 hours), providing the readers with a better comparison of patient characteristics in these groups. The association of all identified confounders with a patient's boarding time was assessed using a linear regression model. Then, the association of boarding time with hospital length of stay was modelled using Poisson regression. Hierarchical Bayesian regression was used for both the linear and Poisson regression analyses to model the repeat visits for some patients during the study timeline, and potential clustering effects by hospital site. This approach explicitly accounts for similarities of outcome that we expect among the same patient who presents multiple times, and simultaneously accounts for similarity of outcome we expect for the same hospital—a practice that improves the accuracy and generalisability of our estimates.[14] An interaction between the primary psychiatric diagnosis and secondary substance use was included to model the effect modification of substance use on psychiatric disorders. Spline functions were used for the patients age, time of admission, wait time and decision time measures to allow for non-linear associations of these predictors with the outcome. Mean value imputation was used for missing predictors as the rate of missing values was low, while patients missing the primary outcome were excluded from the analysis—rates of missing measures were reported.

The interpretation of estimates from a Bayesian analysis differs from frequentist analysis. In a Bayesian analysis, the estimates of association (ie, linear or rate-ratio estimates in our study) are probability distributions representing the range (width) and likelihood (height) of estimates compatible with the study data. The area under a probability distribution is equal to 1 by definition, therefore, the area of this distribution consistent with the effect of interest (in our case the area consistent with a rate-ratio greater than 1 - expected change in length of stay for each 1 hour increase in boarding time) can be reported as a measure of certainty for the effect of interest.[15] For this study, we also describe the median of the probability distribution (ie, the estimate with 50% of the probability distribution above and below) and provide an estimate of the width of the distribution using 87% posterior intervals (PIs). These intervals do not describe 'statistical significance' but rather the uncertainty range compatible with 87% of the patients (87% was selected to represent the majority of patients but be distinct from the 95% CI conventionally used in frequentist hypothesis testing). Visual displays of the entire distribution are also presented.

All statistical analysis was completed in R statistical and computing software. The 'tableone' package was used for descriptive statistics, and 'brms' packages with Stan were used for Bayesian models.[16 17] Study reporting followed the ROBUST checklist for Bayesian analysis.[18]

### Patient and public involvement
Patients or public were not involved in the conduct of this study.

### RESULTS
Of the 22 477 admissions with a primary psychiatric diagnosis during the study time period (n=16 080 unique patients), 19 212 (85%; n=14 261 unique patients) had the primary outcome of length of stay available and were included in our analysis. The average boarding time for all patients was 14 hours (SD: 17.2 hours), while the median boarding time was 6.5 hours (IQR: 1.9–19 hours) (table 1). Patients who were boarded for greater than 14 hours more frequently required a high observation bed (14% vs 3.5%), received an antipsychotic (44% vs 14%) or received sedation (55% vs 33%) while in the ED. In

crude analysis, there was a minimal difference in median hospital length of stay for patients that were boarding for more than 14 hours compared with those boarded for less than 14 hours (8 days vs 9 days; standardised mean difference: 0.025). Median boarding time and median length of stay both varied between the four hospital sites (online supplemental figures 1 and 2) but not over the study timeline (online supplemental figure 3). Mean value imputation was used for three measures, with the frequency of missing data as follows: wait time (n=565; 2.9%), decision time (n=808; 4.2%) and boarding time (n=43; 0.2%).

### Association of confounders with boarding time
The confounders with the strongest association with increased boarding time were requiring a high observation bed (median increase of 16 hours PI: 16–17), antipsychotic use (median increase of 11 hours PI: 10–11), sedative/hypnotic use (median increase of 7 hours PI: 10–11), arrival by police (median increase of 5 hours PI: 4.2–5.8) or MHA detention (2.4 hours PI: 2.1–2.8) (figure 2). Age, wait time and decision time all had non-linear associations with boarding time; boarding time was generally longer for patients who were older or younger than the median age of 47 years, longer for patients with increased wait times and was not influenced by longer decision times. Patients with conduct or neurodevelopmental psychiatric disorders had the highest estimated boarding time while patients with substance use disorder had the lowest (online supplemental figure 4). Secondary substance abuse resulted in the largest increase in boarding time for patients with neurodevelopmental or dissociative disorders but resulted in decreased boarding time for most psychiatric diagnoses (online supplemental figure 5).

### Predictors of length of stay
The predictors with the strongest association with increased hospital length of stay were air ambulance arrival (rate ratio: 1.6; PI: 1.3–1.9), restraint use in the ED (rate ratio: 1.4; PI: 1.3–1.4) and previous admissions in the past year (rate ratio: 1.1; PI: 1.1–1.1). MHA detention and requiring a high observation bed were also associated with increased hospital length of stay (online supplemental figure 6). Patients with eating disorders or psychosis had the longest length of stay (median: 18 days and 16 days, respectively), while patients with substance abuse, trauma, conduct or dissociative disorders had the shortest (online supplemental figure 7). Secondary substance use had the greatest increase in length of stay when used by patients with dissociative disorders but tended to decrease length of stay for patients with somatic or neurocognitive disorders, or psychosis (online supplemental figure 8).

### Effect of boarding time on length of stay
The probability that increased boarding time resulted in longer hospital length of stay was 92% (figure 3). The median rate ratio from the posterior distribution for each 24-hour increase in boarding time was 1.01 (PI: 1.00–1.01). This translates to 0.01 more days in the hospital for a patient who boarded for 24 hours, or 0.02 more days in the hospital for a patient who boarded for 72 hours.

### DISCUSSION
Our results suggest that extended ED boarding time likely results in a minimal increase in hospital length of stay for patients with primary psychiatric disorders. Several key associations of increased boarding time consistent with previous literature were also identified, which could be targets for interventions aimed
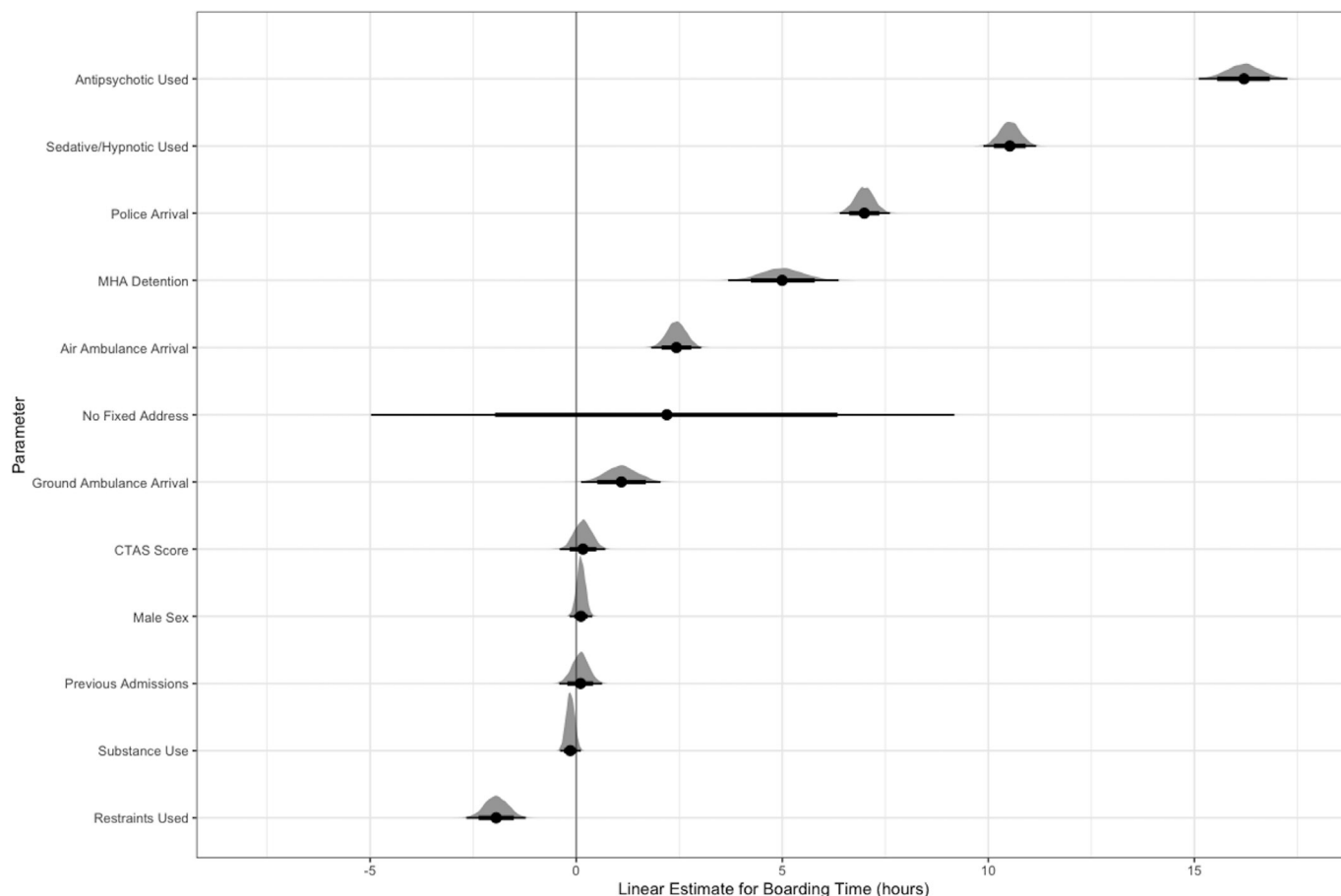
**Figure 2** Probability distributions representing the linear estimates for change in boarding time associated with each parameter. Note: probability distributions represent the range (spread along X-axis) and likelihood (height of distribution) of estimates consistent with the study data. The point indicates median of the distribution, the thick line indicates the 87% PI and the thin line indicates 99% PI. Any area of the probability distribution to the right of 0 indicates an increase in boarding time. Reference category for arrival mode is self-admission. CTAS, Canadian Triage Acuity Scale; MHA, Mental Health Act; PI, posterior interval.

at reducing boarding time in the future. Although our results demonstrate this statistical signal for harm, the absolute increase in length of stay was small and, therefore, boarding time may not reflect a clinically significant cause of morbidity in these patients.

Assessing the causal impact of exposures using observational data is challenging but remains the best means available for providing evidence of potentially harmful exposures (such as boarding time) that cannot be ethically tested in a randomised trial. Our study attempted to quantify the potential morbidity associated with boarding time using an a priori causal model of the relationship, a hierarchical Bayesian analysis and a large, multicentre cohort of patients in an effort to address many of the limitations inherent to observational research. Despite these efforts, unmeasured confounding is always a risk and may account for some of the effect we describe if not correlated with the other confounders we included. Post hoc, we also identified that including all patients (including those admitted to a medical ward rather than strictly a psychiatric unit), we may have selected for many patients that had acute medical needs exacerbating their psychiatric disorders who only required short stays in hospital, reducing the potential effect of boarding time. Additionally, our outcome may have also acted to increase the boarding time of subsequent patients requiring admission, as an increase in length of stay may decrease the availability of inpatient beds when the hospital is nearing capacity. This complex relationship between bed capacity and boarding time was outside the scope of the

current study but may be considered in future studies. Nevertheless, our finding of a high probability that boarding time results in longer length of stay may be a signal for morbidity from this exposure. The small absolute effect we found may also be a positive sign of the resilience of healthcare providers finding ways to initiate treatment for patients with acute psychiatric illnesses while they are boarded in the ED.

Our results were consistent with previous studies identifying the specific psychiatric diagnosis,[6 7] use of physical or chemical restraints,[8] and the day/time a patient accesses the ED as factors associated with increased boarding time.[6 10–12] In addition, we found that detention for mental health assessment and the need for a high-observation bed were strongly associated with increased boarding time. This association may have been due to the severity of the patient, or alternatively may have been correlated with other factors associated with longer lengths of stay. For example, many patients requiring detention or a high-observation bed are agitated or have risky behaviour, and often require substitute decision-makers on a temporary basis while in hospital, or mental health review panels in order to start treatment. This process may increase their boarding time and delay the initiation of treatment, making them more vulnerable to extended hospital length of stay. Furthermore, high-observation beds are a limited resource, which cannot be offloaded to other services, further increasing the boarding time. We also found notable differences in the boarding time and length of stay at
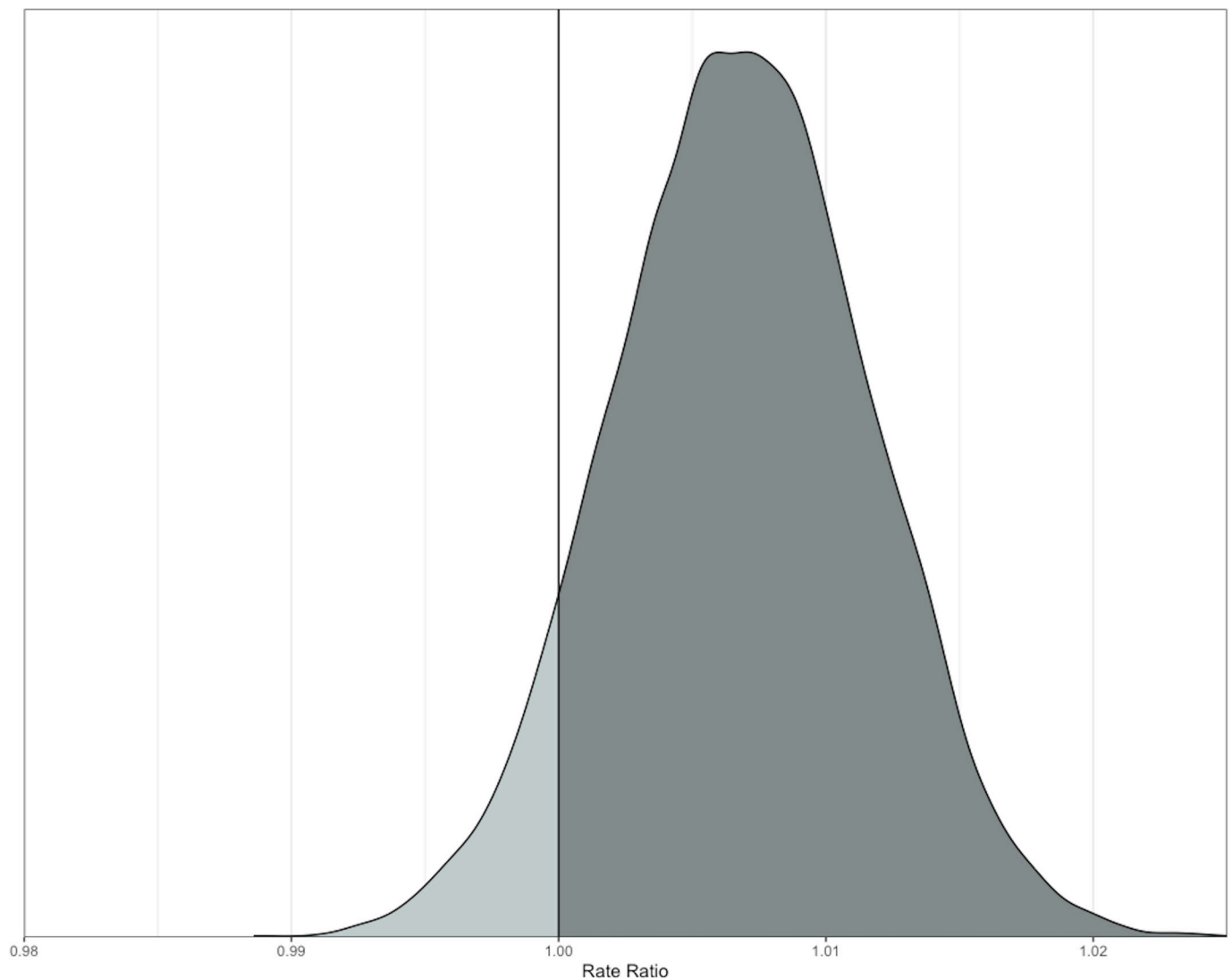
**Figure 3** Estimated probability distribution for the increase in hospital length of stay for each 24-hour increase in boarding time. Note: this probability distribution represents the range (spread along X-axis) and likelihood (height of distribution) of this estimate consistent with the study data. The shaded area of the distribution above 1 indicates the probability consistent with an increased hospital length of stay.

different hospitals. Of particular interest is one site (site D) which had the longest boarding times of all four sites but also had the shortest length of stay. This site uniquely has 24-hour psychiatric nursing care and daily psychiatry rounds in the ED, instead of ED nursing and single psychiatrist providing care. These results may reflect the differences in care models available at different hospital sites.

Concerns about the potential harms of extended boarding times in the ED for patients with psychiatric disorders have been raised by advocacy, physician and government organisations.[5 19 20] Although our results suggest that these interventions specifically targeted to boarding time may have little impact on the patient's hospital length of stay, there are likely other benefits of reducing boarding time that our analysis did not consider, including reducing the distress experienced by all patients, families and care givers in the ED, and addressing the underlying disparities that perpetuate boarding time. Psychiatric boarding may be perpetuated through structural stigma, including funding disparities for mental health services, including inpatient beds, and hospital practices, policies and procedures that restrict the rights of people with mental illness.[21] Distress associated with

extended periods of boarding in the ED on prior admissions may also be a barrier to accessing future psychiatric care for patients.[22] Other studies have proposed solutions to reducing boarding time, including structured discharge planning from psychiatric units,[12] psychiatric rounds in the ED[23] and dedicated psychiatric emergency services.[24] Future studies may consider the causal model we propose (figure 1) to assess the impact of these interventions on alternative outcomes that may better reflect these morbidities.

## Limitations

This study has several limitations. First, we selected patients based on their primary diagnosis of a psychiatric disorder, but this approach may miss patients with serious medical problems likely comorbid to their psychiatric disorder (eg, acute liver failure) that did not have a psychiatric diagnosis documented as their primary diagnosis for that hospital admission. Second, we excluded patients that were missing the primary outcome of hospital length of stay but were unable to determine why this measure was missing from their records. These patients may

represent a unique subpopulation of patients with psychiatric disorders. Third, we did not explicitly consider the inpatient management of these patients in our analysis as all inpatient management could be influenced by the exposure of interest in the ED (ie, on the causal pathway). Factors including treatment type, legal status, patient's capacity and acceptance of treatment, as well as their disposition destination, availability of community supports and outpatient care, no doubt influenced each patient's length of stay. Fourth, we did not consider insurance status of patients as a predictor of boarding time or confounder for length of stay. Although Canada has a universal healthcare system providing no-fee access to hospital for all citizens, private insurance status may reflect patients with better access to community counselling and, therefore, patients at lower risk of requiring hospitalisation. Finally, although we were able to obtain data representing all potential confounders identified a priori in our causal model, the possibility of unmeasured confounders contributing to a spurious effect is always present when randomisation of patients is not possible.

## CONCLUSIONS

Boarding in the ED is a significant health and safety concern in this Canadian jurisdiction with as many as 25% of patients spending nearly a full day awaiting admission under suboptimal circumstances. Boarding was associated with a high probability of increasing the hospital length of stay for psychiatric patients; however, the absolute increase was minimal. Although this signal for harm was slight, longer length of stay may be a sign of increased morbidity for psychiatric patients boarded in the ED for extended periods.

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