Liam Ephraims, ED Data Manager, Royal North Shore Hospital

Mapping key patient-level factors in the ED to Non-Admitted Emergency Target Performance (ETP) breaches from 2015 to 2019 amongst patients in Acute at RNSH, ED

Aim

To capture the key factors within the ED context contributing to non-admitted ETP breaches within our ED, specifically for those within acute area.

Method

Using our historic ED patient-level data from 2015 to 2019, a **logistic regression model** was used to **model ETP breaches for non-admitted patients whose last location in ED was Acute area prior to discharge**, aiming to capture the most influential factors and their level of association between patients being characterized by or experiencing these factors during their visit and the subsequent effect on a patient's likelihood of breaching ETP.

Our final model consists of statistically significant variables from four key groups; **demographic/patient-level** variables (*arrival period* (derived from arrival time), *patient gender*, *Major Diagnostic Block Description* for the patients visit, patient's *age group*, *season*, *day and year* of visit, *triage category*, *mode of arrival* and *source of referral*), **radiology-related variables** (*CT, Ultrasound, Diagnostic Radiology*), **pathology-related variables** (*Routine Bloods, Troponin, Paracetamol level , Ethanol level & Number of Pathology Orders*) and **event-based variables** (such as *specialist consultations, allied health reviews* and event factors such as *requiring booking of transportation* on discharge, having *infectious status*, *scheduling* or identification as a *high-risk faller*).

The effect-size or coefficient of each of these significant variables is explored, representing the average increase or decrease in the odds or the probability of breaching for a non-admitted patient in Acute if this variable was present during a patients visit, thereby allowing us to identify the most important variables in the ED associated with acute non-admitted ETP breach.

Above is a **word-network map of delay reasons in the ED over a more recent period (2017-2019) sub-sample of the same patient cohort**. This visually shows the probability of a patient breaching ETP based

on the words in their delay reason, suggesting that imaging – particularly Computerize Tomography (CT) – may be a major factor in acute non-admitted patients breaching ETP, along with awaiting mental health and allied health reviews and specialist consultations, with these patients having a high percentage of ETP breach indicated by larger red nodes or circles. However, with exactly what the extent of the effect of these interventions have on ETP breach at the individual patient-level being yet unexplored.

The goal then was to obtain these specific effect sizes in terms of the *effect on the odds of breaching or percentage of breaching non-admit ETP at the patient-level* while being able to ***control for key interacting variables*** and leveraging the 'power' of a large five year ED cohort.

Results

As suggested in our word-network delay reasons map, the three major areas contributing to ETP breach among acute, non-admitted patients was confirmed to be radiology imaging, a patient's diagnostic group and thirdly whether patients had transportation booked or had a specialist consultation or review requested or completed. Overall, most significant was **whether a patient had transportation booked**, increasing a patients odds of breaching ***4 to 6 fold*** against those without having transportation booked. Secondly, **whether a patient received Computer Tomography (CT)** was highly significant with high confidence, increasing the odds of breaching by roughly ***4 fold*** for those who had the intervention. Next **Surgical consultations**, followed by **Acute Surgical Unit (ASU) consultations**, **Obstetrics and Gynecological consultations** and **Medical consultations** were strongly associated with ETP breaches, with ***3-4 fold***, ***2-4 fold***, ***2.5-4 fold*** and ***2-4.2 fold*** increases to the odds of breaching respectively, and other types of reviews such as allied health, mental health and social work consultations also having significant impacts on a patients risk of breaching ETP. Lastly, Poisoning, Alcohol abuse, drug induced mental disorders and psychiatric illness diagnosis all greatly increased the odds of breaching against other diagnostic groups, increasing the likelihood of breach for a patient by 2-3 fold, slightly over two and just below three-fold and by an increased 50% to 2-fold respectively.

Furthermore, patients arriving at night shift (+35% increase), during winter (+20%) or spring (+15%), on a Monday (+25%), females (+10%) and those belonging to older age groups (+12% for each 15 year increment in age group) all characterize a high-risk acute non-admitted patient with a significantly increased risk of breaching ETP.

Interestingly, pathology related factors were mixed in effects on ETP, where a patient who has had Paracetamol level orders or Ethanol level orders experiencing an increased risk of breaching likely through association with drug-related and pain-related causes, though overall (unless a patient has had greater than the average of 6-8 pathology orders – likely routine tests) pathology did not seem significantly influential in causing a patient to breach ETP for non-admitted patients in acute, providing rather a protective effect in reducing odds of breach for patients getting 'routine bloods'.

Recommendation

With it being recognized that non-admitted acute ED patients are a major cohort source of ETP breaches and likely preventable targets for reducing ETP breach, it seems intervening at the level of ***ED transport bookings at discharge***, ***CT imaging*** and the ***above key consultations and reviews (Surgical, ASU, Medical)*** are good targets to begin unpacking and exploring areas of preventable breach in the systems surrounding these factors in the ED and further admissions hospital environment.

Summary of Acute Non-admit ETP Coefficients/Effect-sizes:

The final statistical significant (P-value <= 0.05) coefficients or variable effect-size following the analysis for influencing the probability of whether an acute non-admitted patient will breach ETP or not is shown in the table below:

Legend:

Green: Variables with the highest effect on breaching acute non-admit ETP

Red: Associated with increasing the odds of breaching

Blue: Associated with decreasing the odds of breaching

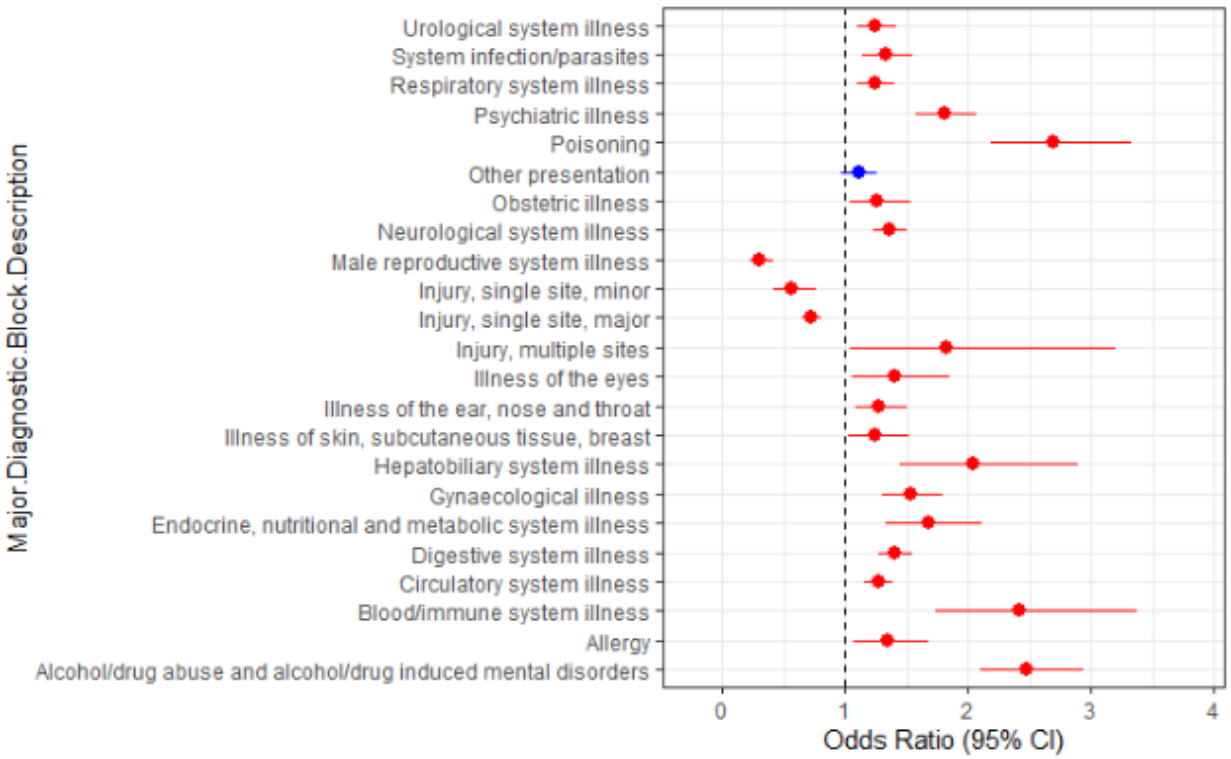
Variable Effect-Sizes (Coefficients) and Statistical Significance:

*Note: A P-value of **less than or equal to 0.05 is defined as statistically significant** in this analysis – meaning the effect on ETP breach is statistically significant amongst the cohort*

Variable	***Effect-size (Coefficient) Interpretation on the odds (%) of breaching ETP***	***Statistical Significance*** *(P-values)*
Arrival Period ***(Night: 20:00-07:59)***	~35% higher odds of breaching ETP for those arriving at night compared to those arriving by day	**<0.001**
Weekday	~25% increase in odds of breaching on Mondays, followed by reduced odds of breaching on weekends – with other days having no statically significant effect	**Monday: <0.001** **Saturday: <0.01** **Sunday: <0.001**

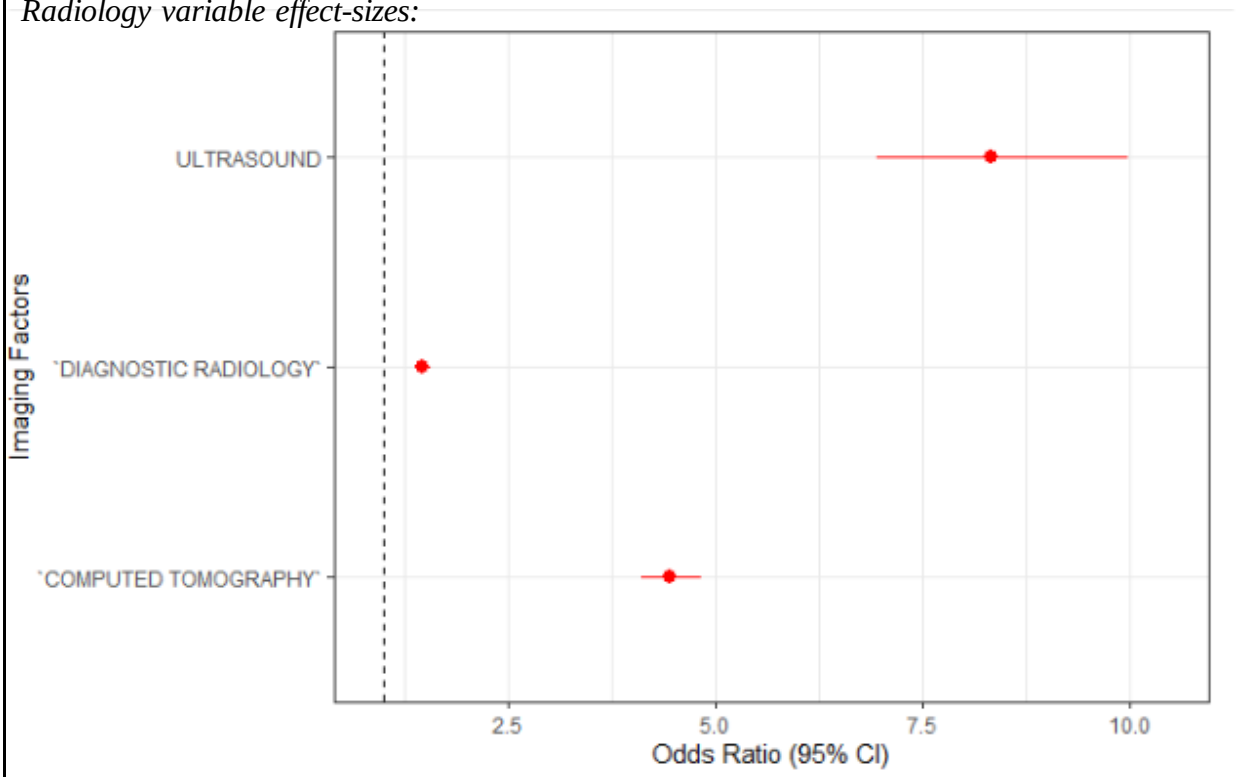
Major Diagnostic Block Group variable effect-sizes (**Red significant/Blue non-significant effect*):

**Reference variable is Musculoskeletal injury*



Major Diagnostic Group*	Most notably the highest effect on breaching was **Poisoning** diagnosis being associated with a 2 to 3- fold (+200%-300%) increase in the likelihood of an acute patient breaching non-admit ETP. Secondly, **Alcohol abuse and drug induced mental disorders** are associated with an increase of slightly over two and just below three-fold increase in odds of breaching. **Psychiatric illness** further increases odds of breaching by +50% to two-fold increase.	**Alcohol/drug abuse and alcohol/drug induced mental disorders: <0.001** **Poisoning: <0.001** **Psychiatric illness: <0.001** ***All other variables except 'Other presentations' had a statistically significant effect on ETP breach**

Age Group	Increased odds of breach by roughly 12% for each age group increase above 14 years of age	**85 & Over: <0.001** **75-84: <0.001** **65-74: <0.001** **46-64: <0.001** **15-30: <0.001** 0-14: >0.05 (*not significant*)
Triage Category	Slightly higher odds of breaching for Category 4 patients (+10%) and reduced odds of breaching for Triage Category 2 patients at around decreased 30% odds of breaching	**Triage Category 2: <0.001** **Triage Category 4: <0.001**
Gender	Males have a reduced odds of breaching than females of roughly (10%)	**<0.001**
Season	Higher likelihood of breaching ETP in Winter (+20%) and Spring (+12%) – Summer and Autumn have no statistically significant impact	**Winter: <0.001** **Spring: <0.001**
Mode of Arrival	Increased odds of breaching in patients arriving by ambulance (+20%). Reduced odds of breaching for walk-ins (-8%)	**Ambulance: <0.001** **Walk-ins <0.01**
Year	2018 and 2019 were most significant increasing the odds of breaching by roughly (+35%) each if a patient arrived in either year	**2018: <0.001** **2019:<0.001**
Source of Referral	Patients who were self-referred have a reduced odds	**<0.001**

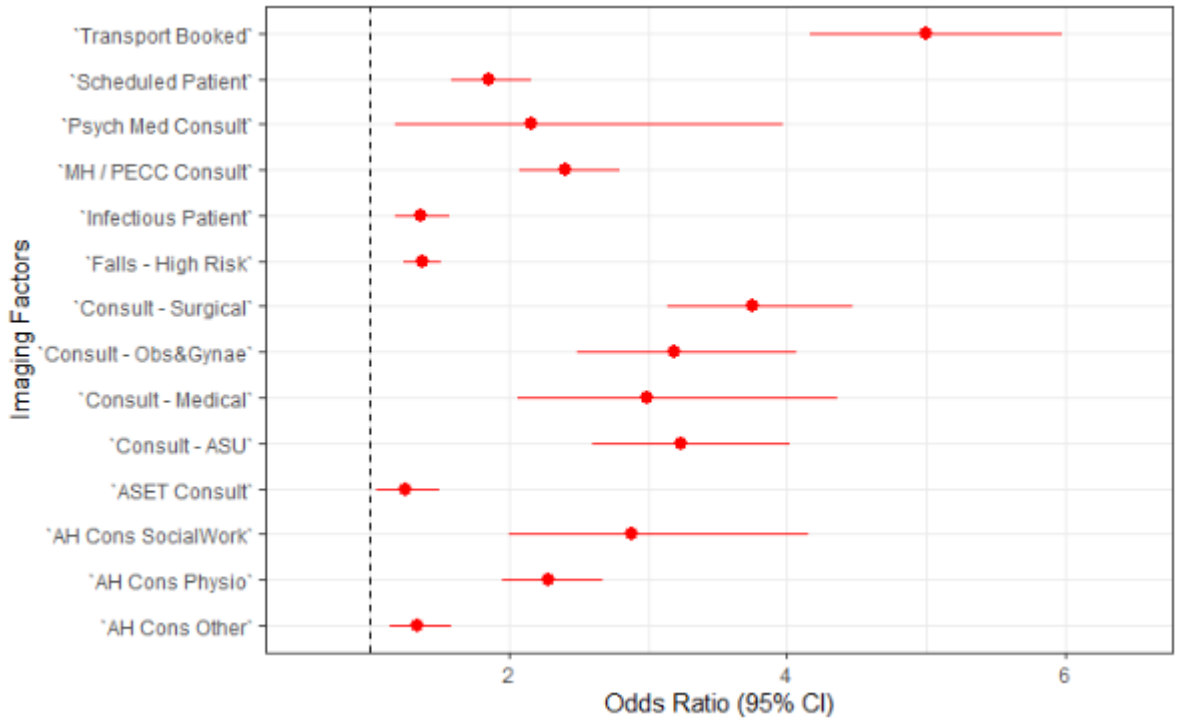
	of breaching by roughly 18% compared with those not self-referred.	
Radiology variable effect-sizes:  ** Imaging odds ratio coefficients. Can observe Ultrasound followed by CT are the most influential on acute non-admit ETP breach – though Ultrasound was a rare event amongst the cohort, unlike CT which was common* *Note: Reference levels are the specific event not happening for each corresponding variable*		
Computer Tomography (CT) *	If a non-admit acute patient has CT imaging they have **greater than a four-fold increase** in the odds of ETP breach (+400%) compared with patients who did not	**<0.001**

Ultrasound	If a non-admit Acute patient had an Ultrasound they have **greater than a six to 10-fold increase in the odds of ETP breach (+600%-1000%)** compared with patients who did not, though only very few patients had ultrasounds overall.	**<0.001**
Diagnostic Radiology	~50% increase in the odds of breaching	**<0.001**
Pathology variable effect-sizes:		
Troponin Order	~25% decrease in the odds of breaching for patients who had a Troponin order completed as opposed to those who did not	**<0.001**
Electrolytes Urea Creatinine Levels Order	Approx. 20% decrease in odds of breaching for patients who had a Electrolytes Urea Creatinine Levels order completed as opposed to those who did not	**<0.01**
Full Blood Count	Decrease of approx. 40% for patients who had a Full Blood Count order completed as opposed to those who did not	**<0.001**
C Reactive Protein	Slight decrease of 5% for patients who had a C Reactive Protein order completed as opposed to those who did not	**<0.001**
Glucose Level	Slight decrease of ~5% in odds of breaching for patients who had a Glucose Level	**<0.001**

	order completed as opposed to those who did not	
Liver Functions	Decrease of ~15% in odds of breaching for patients who had a Liver Functions order completed as opposed to those who did not	**<0.001**
Coagulation Profile	Decrease of ~10% in odds of breaching for patients who had a Coagulation Profile order completed as opposed to those who did not	**<0.001**
Beta HCG Quantification	~Decrease of ~10% in odds of breaching for patients who had a Coagulation Profile order completed as opposed to those who did not	**<0.001**
Lipase Level	~Decrease of ~5% in odds of breaching for patients who had a Lipase level order completed as opposed to those who did not	**<0.001**
Thyroid Function Test	~Decrease of ~7% in odds of breaching for patients who had a Thyroid Function order completed as opposed to those who did not	**<0.001**
Blood Group and Antibody Screen	~Decrease of ~10% in odds of breaching for patients who had a Blood Group and Antibody Screen order completed as opposed to those who did not	**<0.001**
Paracetamol Level	~Increase of nearly two-fold (200%) in odds of breaching for patients who had a Paracetamol Level order	**<0.001**

	completed as opposed to those who did not	
Ethanol Level	~Increase of ~12% in odds of breaching for patients who had an Ethanol Level order completed as opposed to those who did not	**<0.001**

Review/Consultation and other ED variable effect-sizes:



** Review/Consultation and other ED (e.g. Transport bookings, scheduled and infectious patients) odds ratio coefficients. Can observe transport bookings followed by Consults (Surgical, ASU, Obs & Gynae and Medical) as being most influential on acute non-admit ETP breach.*

Note: Reference levels are the specific event not happening for each corresponding variable

Interpretation:

Transport Booked	**~Increase of 4 to 6 fold** in the odds of breaching for non-admit acute patients for those who had Transport Booked (requested, started and completed events) against	**<0.001**

	those who did not have a Transport Booked event	
Consult – Surgical	**~ Increase of 3 to 4-fold** in odds of breaching for patients who had a Surgical Consultation against those who did not	**<0.001**
Consult – Obs & Gynae	**~ Increase of 2.5 to 4-fold** in odds of breaching for patients who had a Obs or Gynae Consult against those who did not	**<0.001**
Consult – Medical	**~ Increase of 2 to 4-fold** in the odds of breaching for patients who had a Medical Consult as compared with those who did not	**<0.001**
ASET Consult	Increase of 5% to 50% in the odds of breaching ETP in patients who had an ASET Consult against those who did not	**<0.01**
AH Consult Social Work	~Increase of 2 to 4 fold in the odds of breaching against not breaching in patients who had a Social Work Consult as opposed to those who did not	**<0.001**
AH Cons Physio	~Increase of 2-fold to 270% (2.7 fold) in the odds of breaching in patients who had a Physiotherapy Consultation against those who did not	**<0.001**
AH Cons Other	~Increase of approximately 10% to 50% in the odds of breaching for those who had an Allied Health Consultation of a different type than those	**<0.001**

	specified against those who did not	
Consult – ASU	~**Increase of 2 to 4 fold** in the odds of breaching against not breaching in patients who had an Acute Surgical Unit (ASU) Consult as opposed to those who did not	**<0.001**
Psych Med Consult	~Increase of 20%(0.2) to 4 fold in the odds of breaching against not breaching in patients who had a Psych Med Consult Consult as opposed to those who did not	**<0.001**
MH / PECC Consult	~Increase of 2 to 2.7 fold in the odds of breaching against not breaching in patients who had a MH/PECC Consult as opposed to those who did not	**<0.001**
Scheduled Patient	~Increase of 25 to 60% in the odds of breaching for Scheduled Patients against non-scheduled patients	**<0.001**
Infectious	~Increase of 15 to 35% in the odds of breaching for Infectious Patients against non-infectious patients	**<0.001**
High Risk – Falls	~Increase of 25 to 40% in the odds of breaching for High risk fall Patients against those not identified as high-risk falls patients	**<0.001**

Some interaction effects of interest:

CT Imaging Order & Circulatory System illness	If a non-admitted Acute **patient who had a circulatory illness related diagnosis and has a CT they have a two-fold increase** in the risk of breaching, in addition to the increased risk of having a CT (four-fold increase) and having a circulatory related-illness (average-effect) separately.	**<0.01**
CT Imaging Order & Digestive System illness	If a non-admitted Acute **patient who had a Digestive illness related diagnosis and has a CT they have a two-fold increase** in the risk of breaching, in addition to the increased risk of having a CT (four-fold increase) and having a digestive system related-illness separately (20% increase).	**<0.01**
CT Imaging Order & Respiratory System illness	If a non-admitted Acute **patient who had a Respiratory illness related diagnosis and had a CT they have a two-fold increase** in the risk of breaching, in addition to the increased risk of having a CT (four-fold increase) and having a respiratory system related-illness separately.	**<0.01**