**Appendix**

**Table 1A: Balance Test for Random Assignment Across Physicians**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Chief Complaints** | **Frequency No. (%)** | **F-Statistic** | ***p-value*** | ***Bonferroni Adjusted p-value*** |
| Abdominal Complaints | 6,232 (14%) | 1.401 | 0.095 | 1.00 |
| Abnormal Test Results | 1,816 (4%) | 2.015 | 0.002 | 0.07 |
| Back or Flank Pain | 2,550 (6%) | 1.029 | 0.423 | 1.00 |
| Cardiac Arrhythmias | 1,044 (2%) | 0.912 | 0.583 | 1.00 |
| Chest Pain | 3,521 (8%) | 1.042 | 0.406 | 1.00 |
| Dizziness/Lightheadedness/Syncope | 1,894 (4%) | 0.921 | 0.570 | 1.00 |
| Extremity Complaints | 5,259 (12%) | 0.991 | 0.472 | 1.00 |
| Assaults and Trauma | 2,381 (5%) | 0.773 | 0.769 | 1.00 |
| Fatigue and Weakness | 1,494 (3%) | 0.681 | 0.869 | 1.00 |
| Fevers, Sweats, or Chills | 1,842 (4%) | 1.132 | 0.299 | 1.00 |
| Gastrointestinal Issues | 3,323 (8%) | 1.027 | 0.425 | 1.00 |
| Neurological Issue | 3,492 (8%) | 0.707 | 0.843 | 1.00 |
| Shortness of Breath | 2,962 (7%) | 1.198 | 0.232 | 1.00 |
| Skin Complaints | 2,176 (5%) | 1.021 | 0.433 | 1.00 |
| Upper Respiratory Symptoms | 1,915 (4%) | 1.239 | 0.197 | 1.00 |
| Urinary Complaints | 1,399 (1%) | 1.837 | 0.009 | 0.213 |
| **Emergency Severity Index (ESI)** | **Frequency No. (%)** | **F-Statistic** | ***p-value*** | ***Bonferroni Adjusted p-value*** |
| ESI 1 | 450 (1%) | 0.884 | 0.621 | 1.00 |
| ESI 2 | 13,463 (31%) | 1.304 | 0.149 | 1.00 |
| ESI 3 | 24,679 (57%) | 0.867 | 0.645 | 1.00 |
| ESI 4 | 4,572 (11%) | 1.414 | 0.090 | 1.00 |
| ESI 5 | 135 (0%) | 1.302 | 0.151 | 1.00 |
| **Vital Signs** | **Frequency No. (%)** | **F-Statistic** | ***p-value*** | ***Bonferroni Adjusted p-value*** |
| Tachycardic |  | 1.390 | 0.100 | 1.00 |
| Tachypneic |  | 1.176 | 0.254 | 1.00 |
| Febrile |  | 1.708 | 0.019 | 0.463 |
| Hypotensive |  | 1.054 | 0.390 | 1.00 |

*This table presents the results of Wald tests designed to evaluate the balance of chief complaints, Emergency Severity Index (ESI), and patient vital signs across physicians in our dataset. The tests compare models with and without physician identifiers as predictors for each listed variable, assessing whether the distribution of these variables is consistent across physicians, as expected under random assignment. Each row represents a separate Wald test, with the F-statistic indicating the test strength and the p-value showing the likelihood that any observed differences could occur by chance. A balanced distribution, indicated by non-significant p-values (typically p > 0.05), supports the assumption of random assignment. Robust standard errors (type HC1) accounted for potential heteroscedasticity in the data.*

**Figure 1A: ROC Curves and AUC Scores for Logistic Regression Predicting Batching Status**

A graph of a curve

Description automatically generated

**Figure 2A: Predicted Impact of Physician Batch Tendency on Batch Ordering Probability**

A graph with blue lines and black text

Description automatically generated

This figure shows the effect of a physician's "batch tendency" on the predicted probability (with 95% confidence intervals) of batch ordering at a given patient encounter, conditional on time, patient complaint, and severity, from a logistic regression model controlling for these features. The construction of the batch tendency measure is described in the manuscript. Batch tendency, which is entirely independent of the given patient encounter, is predictive of batching during the given encounter. Standard errors are clustered at the physician level.

**Figure 3A: Distribution of ED Length of Stay Before and After Log Transformation**

A graph of a long line

Description automatically generated with medium confidence

**Table 2A: Robustness of Batching Definition**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | | Dependent Variables | | | |
|  | |  | |  |  |  |
| Criteria | | Independent  Variable | | ln(LOS) | 72-Hour Return and Admission | Number of Distinct Imaging Tests |
| **Batching Criteria is 1 minute** | | Batch Tendency | | 0.044\*\*  (0.020) | -0.002\*\*\*  (0.001) | 0.079\*\*\*  (0.007) |
|  | |  | |  |  |  |
| **Batching criteria is 10 minutes** | | Batch Tendency | | 0.042\*\*  (0.020) | -0.001\*\*\*  (0.0005) | 0.080\*\*\*  (0.007) |
|  | |  | |  |  |  |
| **Batching criteria is 20 minutes** | | Batch Tendency | | 0.039\*\*  (0.020) | -0.002\*\*\*  (0.0004) | 0.081\*\*\*  (0.006) |
|  | |  | |  |  |  |
| **Batching criteria is 30 minutes** | | Batch Tendency | | 0.038\*  (0.021) | -0.002\*\*\*  (0.0004) | 0.083\*\*\*  (0.005) |
|  | |  | |  |  |  |
| **Batching criteria is >=3 tests** | | Batch Tendency | | 0.012  (0.020) | -0.002\*\*\*  (0.001) | 0.047\*\*  (0.023) |
|  | |  | |  |  |  |
| **Batching criteria is >=4 tests** | | Batch Tendency | | -3.190  (3.175) | -0.073  (0.086) | 3.994\*  (2.165) |
|  | |  | |  |  |  |
| **Batching criteria includes**  **batches that are not in the first set of tests ordered** | | Batch Tendency | | 0.046\*\*  (0.021) | -0.002\*\*\*  (0.0005) | 0.080\*\*\*  (0.007) |
|  | |  | |  |  |  |

*The coefficient comes from a multivariable linear regression where we regress batch tendency on our primary outcomes. control for time and shift fixed effects (necessary for quasi-random assignment), patient-level variables, hospital occupancy, whether the patient also had laboratory tests ordered during their visit, and vital signs. The table shows that results are robust to batching definition. Standard errors are clustered at the physician level.*

*\*p<0.1; \*\*p<0.05; \*\*\*p<0.01*

**Table 3A: Methodology for Grouping of Unique Complaints**

|  |  |
| --- | --- |
| **Grouped Complaint Area** | **Entered Complaint in Data** |
| Abdominal Complaints | Abdominal Cramping, Abdominal Distention, Dyspepsia, Abdominal Pain, Ascites, Hernia, Abdominal Aortic Aneurysm, Abdominal Injury, Pancreatitis, Umbilical Hernia |
| Abnormal Test Results | Abnormal Lab, Abnormal Potassium, Abnormal Calcium, ECG Changes, Abnormal ECG, Abnormal Test Result, Blood Infection, Acute Renal Failure, Hypocalcemia, Chronic Renal Failure, Pulmonary Embolism, Abnormal X-ray, Hypoglycemic Unawareness, Elevated Blood Pressure, Abnormal Sodium, Hyperglycemia, Hyponatremia, Platelet Disorders, Anemia, Hypoglycemia, Hypertension, Hypotension, Abnormal Chest Imaging, Abnormal Oximetry, Abnormal Stress Test, Blood Sugar Problem, Hypocalcemia, Hyponatremia |
| Allergic Reaction | Allergic Reaction, Anaphylaxis |
| Back or Flank Pain | Back Pain, Back Problem, Flank Pain, Sciatica, Back Injury, Disc Disorder |
| Breast Complaints | Breast Mass, Breast Pain, Breast Problem, Breast Discharge, Breast Cancer, Breast Discharge, Breast Inflammation |
| Cardiac Arrhythmias | Atrial Fibrillation, Atrial Flutter, Cardiac Valve Problem, Bradycardia, Irregular Heart Beat, Palpitations, POTS, Ventricular Tachycardia, Rapid Heart Rate, Heart Problem, Cardiac Arrest, Congestive Heart Failure, Circulatory Problem, Transient Ischemic Attack, Ventricular Tachycardia |
| Chest Pain | Chest Injury, Chest Pain, Chest Wall Pain, Angina, Collarbone Injury, Rib Injury, Heart Pain |
| Dizziness / Lightheadedness / Syncope | Dizziness, Near Syncope, Syncope, Vertigo, Spells, Hypotension, Paroxysmal Positional Vertigo, Paroxysmal Positional Vertig |
| Ear Complaints | Cerumen Impaction, Ear Drainage, Ear Fullness, Ear Laceration, Ear Problem, Earache, Hearing Problem, Tinnitus, Ear Injury, Hearing Loss, Nasal Trauma |
| Epistaxis | Epistaxis, Epistaxis (Nose Bleed), Nose Problem" |
| Exposures, Bites, and Envenomation | Animal Bite, Body Fluid Exposure, Chemical Exposure, Poisoning, Exposure to STD, Insect Bite, Smoke Inhalation, Radiation, Snake Bite, Toxic Inhalation |
| Extremity Complaints | Ankle Injury, Ankle Pain, Arm Injury, Arm Pain, Cold Extremity, Arm Swelling, Arthritis, Elbow Injury, Elbow Pain, Pseudogout, Extremity Pain, Extremity Weakness, Finger Injury, Hip Injury, Extremity Weakness, Finger Injury, Finger Pain, Dislocation, Foot Infection, Foot Injury, Foot Numbness, Foot Pain, Foot Swelling, Foot Ulcer, Foot Wound Check, Hand Injury, Hand Pain |
| Eye Complaints | Blurred Vision, Decreased Visual Acuity, Diplopia, Detached Retina, Eye Drainage, Eye Exposure, Eye Pain, Eye Problem, Eye Swelling, Eye Trauma, Foreign Body Eye, Flashes / Light, Loss of Vision, Red Eye, Visual Field Change, Eyelid Problem, Itchy Eye, Eye Exam, Burning Eyes, Eye Twitching, Eyelid/brow Lift Evaluation, Strabismus, Glaucoma, Spots / Floaters |
| Assaults and Trauma | Assault Victim, Concussion, Facial Injury, Fall, Nasal Trauma, Head Injury, Head Laceration, Motor Vehicle Crash, Puncture Wound, Sexual Assault, Trauma, Domestic Violence, Gun Shot Wound, Work-Related Injury, Motorcycle Crash, Injury, Bicycle Accident, Near Drowning, Lip Laceration" |
| Fatigue and Weakness | Difficulty Walking, Fatigue, Gait Problem, Weakness-Generalized, Chronic Fatigue, Weakness- Generalized |
| Fevers, Sweats or Chills | Chills, Diaphoresis, Fever, Night Sweats, Diaphoretic, Diapohresis, Hoarseness, Laryngitis |
| Foreign Body | Food Bolus, Foreign Body, Foreign Body in Ear, Foreign Body in Skin, Foreign Body in Vagina, Swallowed Foreign Body, Foreign Body in Nose, Foreign Body, FB eye, Foreign Body in Rectum |
| Gastrointestinal Issues | Anal Fissure, Black or Bloody Stool, Constipation, GERD, Anal Fistula, Diarrhea, Dysphagia, Fecal Impaction, Fistula Follow Up, GIbleeding, GI Problem, Hemorrhoids, Morning Sickness, Nausea, Ostomy Care, Rectal Bleeding, Rectal Pain, Vomiting, Vomiting Blood, Vomiting During Pregnancy, GI Bleeding, Fecal Incontinence, Bloated, Hematochezia, Urine Leakage, Heartburn, Rectal Discharge, Urolithiasis, Ulcerative Colitis, Irritable Bowel Syndrome, Rectal Prolapse, Fistula Evaluation, Rectal Problems, Perianal Abscess, Fisula Evaluation, Stoma Dysfunction |
| Genital Complaints | Groin Burn, Groin Pain, Groin Swelling, Inguinal Hernia, Menstrual Problem, Pelvic Pain, Penis Pain, Priapism, Testicle Pain, Menorrhagia, Vaginal Bleed, Vaginal Bleeding, Vaginal Itching, Bartholin's Cyst, Genital Warts, Groin Injury, Vaginal Bleeding-Pregnant, Vag Bleed Pregnant, Female Genital Issue, Penis Injury, Vaginal Discharge, Vaginal Pain, Erectile Dysfunction, Vaginal Prolapse, Urethral Stricture, Penile Discharge, Menorrhagia, Gynecologic Exam, Menstrual Problem, Vaginitis/Bacterial Vaginosis, Ovarian Cyst, Vaginitis / Bacterial Vaginosis |
| Medical Device or Treatment Issue | Cast Problem, Device Check, Dressing Change, Feeding Tube, AICD Problem, Insulin Pump Visit, Gastrostomy Tube Change, Medication Reaction, Shunt, Appliance Removal, Tube Problem, Urinary Catheter Change, Vascular Access Problem, Enteral Nutrition Evaluation, Device Malfunction, Pacemaker Problem, Removal / Exchange Catheter, Drain Removal, Outpatient Infusion, Treatment, Heart Assist Device, Stoma Dysfunction, Tracheostomy Tube Change, Ureteral Stent Exchange |
| Medication Request | Immunizations, Infusion / Injection Administration, IV Medication, Infusion/ Injection Administ, Med Refill, Medication Visit, Pain Management, Blood Product Administration, Labs Only, Tetanus (Td & Tdap), Wound Care |
| Neurological Issue | Altered Mental Status, Cognitive Concerns, Facial Droop, Pre Syncope, Focal Weakness, Headache, Memory Loss, Migraine, Dementia, Dysphasia, Neuro Problem, Numbness, Paralysis, Seizures, Slurred Speech, Spasms, Stroke Like Symptoms, Tingling, Tremors, Trigeminal Neuralgia, Unable to Speak, Seizure Disorder, Insomnia, Parkinson's Disease, Loss of Consciousness, Neuropathy, Ataxia, Unable to speak, Peripheral Neuropathy, Stroke, Cerebrovascular Accident, Speech Problem, Acute Neurological Problem, Flashes, Light, Unresponsive, Multiple Sclerosis, Parkinson's Disease, Febrile Seizure, Paresthesia, Peripheral Neuropathy, Hydrocephalus, Spasticity, Neuroendocrine Tumor |
| Other | Dehydration, Fisula Evaluation, Follow-Up, Illness, Letter for School/Work, Aneurysm, Lung Eval, Error, Mass, Oral Swelling, Other, Advice Only, Deformity, Electric Shock, Personal Problem, Shaking, Swelling, Swollen Glands, Adenopathy, Adrenal Problem, Thrombophilia, Weight Gain, Weight Loss, Hiccups, , Chemo Related Symptoms, Hot Flashes, Follow-up, Non Healing Wound, (Other), Mouth Injury, Xerostomia, Prostate Check, Suture / Staple Removal, Wellness, Voice Changes, Vital Sign Check, Coagulation Disorder, Cold Exposure, Consult, Dental Problem, Tetanus (Td & Tdap), Infusion/ Injection Administ, Tracheostomy Tube Change, Medical Information, Neutropenic Fever, Infection, Leukemia, Heat Exposure, Poor Appetite, Gingivitis, Pre-op Exam, gingivitis, Loss of appetite, Failure To Thrive, Referral, Lymphoma, Hot Flashes, Neutropenia, Radiation, Ingestion, TB Test, Fussy, Lupus, Toxic Inhalation, Lung Screening, Leakage/Loss of Fluid, Liver Eval, Hepatic Cancer, Lung Mass, Venous Thromboembolic Disease, Insulin Pump Visit, Preventive Visit, Avulsion, Peripheral Edema, Hypoglycemic Unawareness, Immobility, Giant Cell Arteritis, Polydipsia, Platelet Disorders, Post-procedure, Lung Follow-up, Poisoning, Injections, POTS, Insulin Reaction, Liver Transplant, Labs Only" |
| Other Pain | Dental Pain, Facial Pain, Generalized Body Aches, Myalgia, Dental Injury, Jaw Pain, Muscle Pain, Neck Pain, Pain, Sickle Cell Pain Crisis, Paresthesia, Torticollis, Chronic Pain, Cancer Pain, Incisional Pain, Bone Pain, Tailbone Pain, Gout, Muscle pain/Weakness, Pseudogout |
| Post-Op Issue | Post-Op, Post-Procedure, Post-Op Problem, Post-op, Post-Op Issue, Wound Dehiscence, Post-op Problems, Post-op Problem |
| Psychiatric Complaints | Anxiety, Auditory Hallucinations, Depression, Panic Attack, Homicidal, PTSD (Post-Traumatic Stress, Delusional, Fussy, Paranoia, Suicide Attempt, Hallucinations, Manic Behavior, Eating Disorder, Suicidal, Agitation, Psychiatric Evaluation, Aggressive Behavior, Mental Health Problem, Inappropriate Words |
| Shortness of Breath | Airway Obstruction, Aspiration, Pain With Breathing, Near Drowning, Respiratory Distress, Shortness of Breath, Wheezing, Increased Work Of Breathing, Difficulty Breathing, Choking, Oxygen Dependence, Hyperventilating, Orthopnea |
| Skin Complaints | Abrasion, Abscess, Bleeding/Bruising, Blister, Angioedema, Lip Laceration, Burn, Cellulitis, Cyst, Drainage from Incision, Disturb of Skin Sens, Edema, Extremity Laceration, Facial Burn, Cyanosis, Impetigo, Facial Laceration, Facial Swelling, Finger Laceration, Leg Rash, Herpes Zoster, Hives, Itching, Jaundice, Diabetic Ulcer, Diabetic Wound, Laceration, Mouth Lesions, Non-Healing Wound, Rash, Recurrent Skin Infections, Skin Problem, Sore, Scabies, Suture \ Staple Removal, Wound Check, Wound Infection, Lesion, Skin Check, Minor Skin Infection, Skin Ulcer, Skin Discoloration, Sunburn, Head Lice, Scabies, Fungal Infection, Leg Rash, Impetigo |
| Substance Abuse Issues | Alcohol Intoxication, Alcohol Problem, Withdrawal, Drug Overdose, Drug / Alcohol Dependency, Addiction Problem, Addiction Assessment, Delirium Tremens (DTS) |
| Upper Respiratory Symptoms | Congestion, Cough, Coughing Up Blood, Flu Symptoms, Enlarged Tonsils, Peritonsillar Abscess, Nasal Congestion, Sinus Symptoms, Sinusitis, Sore Throat, Hoarseness, Throat Problem, Upper Respiratory Infection, Influenza, Laryngitis, Respiratory Arrest, Pneumonia, Pleural Effusion, Asthma, Croup, URI, Peritonsillar Abscess |
| Pregnancy Related | Pregnancy Problem, Miscarriage, Contractions, Ectopic Pregnancy, Laboring, Possible Pregnancy, Pregnancy Related |
| Renal | Av Fistula, Kidney Transplant, Elevated Serum Creatinine, End-Stage Liver Disease, Hemodialysis Access, Nephritis, Ureteral Stent Exchange |
| Urinary Complaints | Bladder Problem, Blood in Urine, Cystitis, Difficulty Urinating, Dysuria, Gross Hematuria, Painful Urination, Urinary Frequency, Urinary Symptom, Urinary Incontinence, Urinary Problem, Urinary Retention, Slowing Urinary Stream, Urinary Tract Infection, Urinary Urgency, Voiding Dysfunction, Hesitancy Urinary |