

Title: Police Transport for Penetrating Trauma

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Objective: Police in Philadelphia, Pennsylvania routinely transport patients with penetrating trauma to nearby trauma centers. During the past decade, this practice has gained increased acceptance, but outcomes resulting from police transport of these patients have not been recently evaluated. This study assesses mortality among patients with penetrating trauma who are transported to trauma centers by police vs. emergency medical services (EMS).

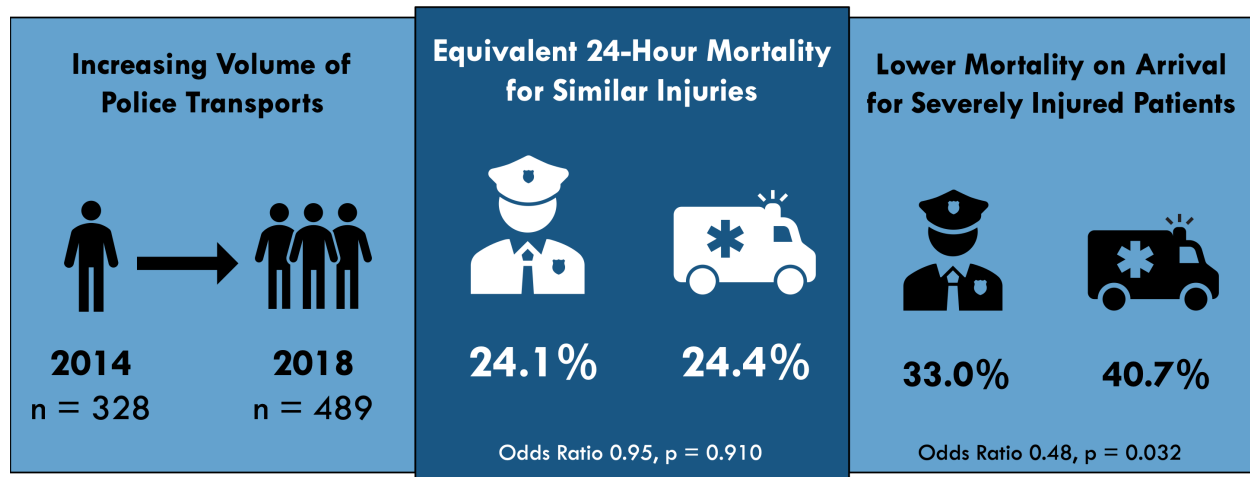
Design, Setting, and Participants: This cohort study used the Pennsylvania Trauma Outcomes Study registry and included 3313 adult patients with penetrating trauma from January 1, 2014, to December 31, 2018. Outcomes were compared between patients transported by police (n = 1970) and patients transported by EMS (n = 1343) to adult level I and II trauma centers in Philadelphia.

Outcomes and Measures: The primary end point was 24-hour mortality. Secondary end points included death at multiple other time points. After whole-cohort regression analysis, coarsened exact matching was used to control for confounding differences between groups. Subgroup analysis was performed among patients with low, moderate, or high injury severity scores.

Results: Of the 3313 patients (median age, 29 years [interquartile range (IQR) 23-40 years]) in the study, 3013 (90.9%) were men. During the study period, the number of police transports increased significantly (from 328 patients in 2014 to 489 patients in 2018; $P = .04$), while EMS transport remained unchanged (from 246 patients in 2014 to 281 patients in 2018; $P = .44$). On unadjusted analysis, compared with patients transported by EMS, patients transported by police were younger (median age, 27 years [IQR 22-36 years] vs 32 years [IQR 24-46 years]), more often injured by a firearm (1741 of 1970 [88.4%] vs 681 of 1343 [50.7%]), and had a higher median ISS (14 [IQR 9-26] vs 10 [IQR 5-17]). Patients transported by police had higher mortality at 24 hours than those transported by EMS (560 of 1970 [28.4%] vs 246 of 1343 [18.3%]; odds ratio, 1.86; 95% CI, 1.57-2.21; $P < .001$) and at all other time points. After coarsened exact matching (870 patients in each transport cohort), there was no difference in mortality at 24 hours (210 [24.1%] vs 212 [24.4%]; odds ratio, 0.95; 95% CI, 0.59-1.52; $P = .91$) or at any other time point. On subgroup analysis, patients with severe injuries transported by police were less likely to be dead on arrival compared with matched patients transported by EMS (64 of 194 [33.0%] vs 79 of 194 [40.7%]; odds ratio, 0.48; 95% CI, 0.24-0.94; $P = .03$).

Conclusions: For patients with penetrating trauma in an urban setting, 24-hour mortality was not different for those transported by police vs EMS to a trauma center. Timely transport to definitive trauma care should be emphasized over medical capability in the prehospital management of patients with penetrating trauma.

Figure. Key Study Takeaways



The Variable Role of Damage Control Laparotomy Over 19 Years of Trauma Care in Pennsylvania

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Background: Damage Control Laparotomy (DCL) gained popularity in the 2000s to emphasize physiologic stabilization of critically injured patients, and to allow staged surgical management of intraabdominal injuries. We examined variability between centers and over time in Pennsylvania.

Methods: We analyzed Pennsylvania Trauma Outcomes Study (PTOS) data from 2000-2018, excluding centers performing <10 laparotomies/year. Laparotomy was defined using ICD codes for open abdominal operations and DCL was defined by a code for “reopening of recent laparotomy” or a return to the operating room >4hrs from index laparotomy without a flag for unplanned reoperation. We examined trends over time and by center. A multivariable logistic regression model predicting DCL was used to generate observed:expected (O:E) ratios and identify outliers in DCL use. We then compared risk-adjusted mortality rates to center-level DCL rates.

Results: Over 19 years, 15,627 laparotomies from 21 centers were analyzed. 2,591 DCLs were performed (16.6% of all laparotomies). Use of DCL in PA varied from 9.8% to 20.7% over time, with more variation in recent years after adjustment (Figure 1). There was wide variation in center-level use of DCL, from 6.6% to 33.7%; after adjustment for patient-level and injury characteristics, this variation persisted (Figure 2). Factors associated with DCL included injury severity, severity of abdominal injury, and admission vital signs. Center identity improved the model as demonstrated by likelihood ratio test ($p<0.001$), suggesting differences in center-level practices. Of the 6 high-mortality outlier centers, there were 2 high and 2 low outliers for DCL use, suggesting minimal correlation between center-level DCL use and mortality.

Conclusion: There is wide center-level variation in DCL use in PA that persists after adjustment for patient factors. Future quality improvement efforts may aim to optimize DCL utilization.

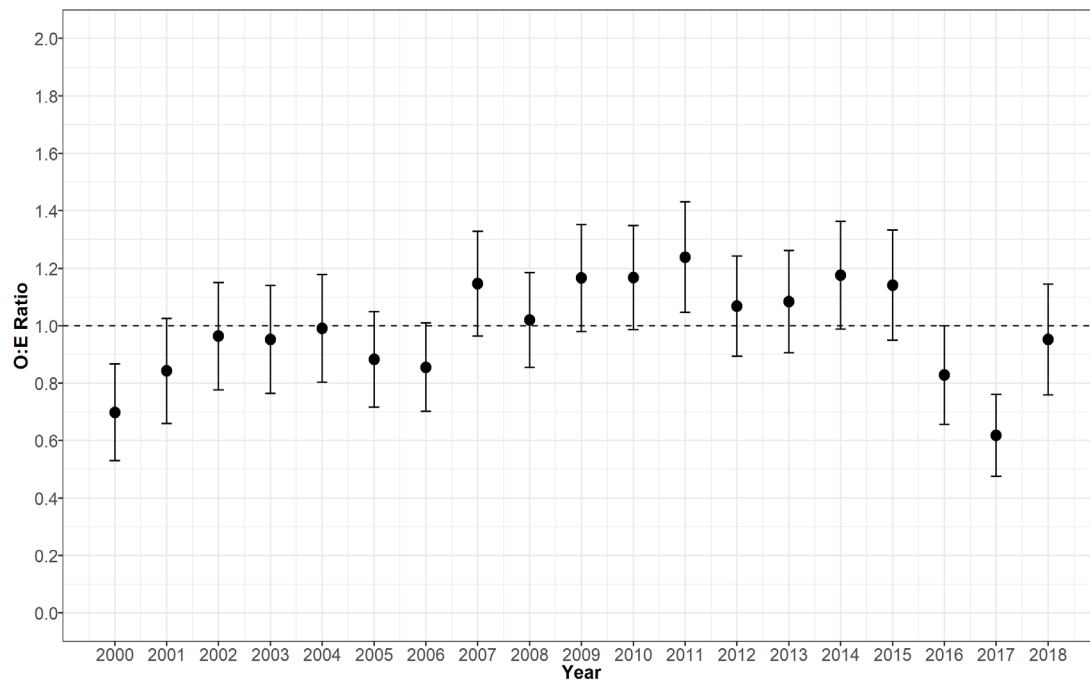


Figure 1. Overall risk-adjusted DCL rate in PA over time.

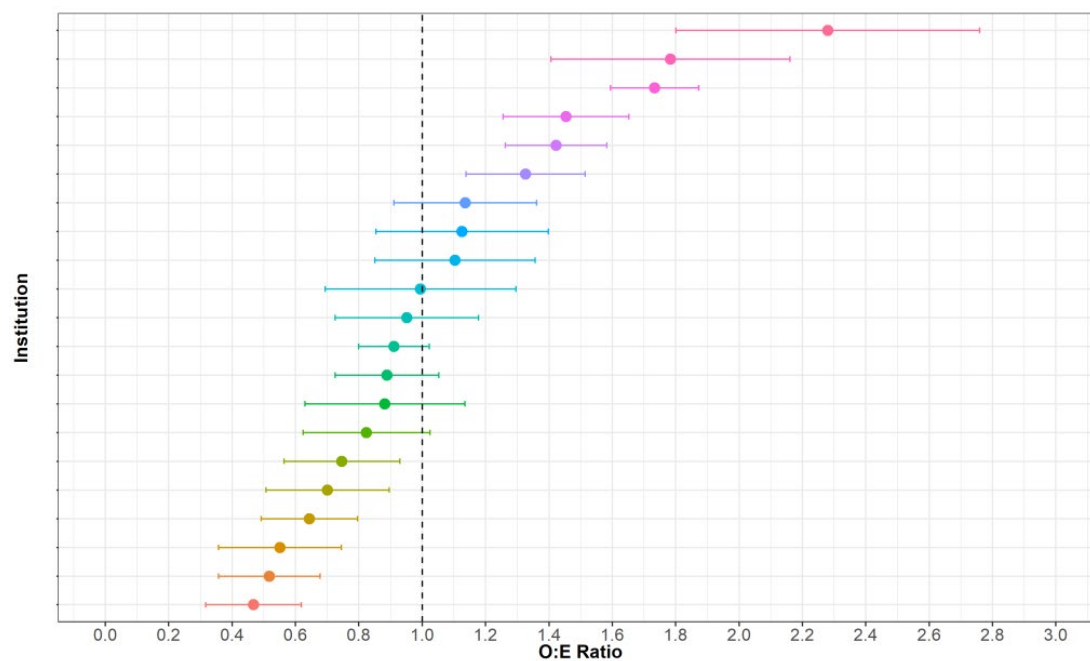


Figure 2. O:E ratios for use of DCL by center.

Abstract

Title: Factors associated with post-acute functional status and discharge dispositions in individuals with spinal cord injury

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Background: Research has evaluated the effect of surgical timing on patient functional recovery in individuals with spinal cord injury (SCI); however, there is a critical need to assess how demographics, clinical characteristics, and process of care affect functional outcomes.

Objective: We examined the association between demographic, clinical, and process of care factors with post-acute functional status (locomotion and transfer mobility scores) and discharge disposition (home vs. institution) in individuals with SCI.

Methods: This study was a retrospective cohort analysis of the Pennsylvania Trauma Systems Outcomes Study (PTOS) database for individuals with traumatic SCI (N = 2223). We conducted multinomial and binomial logistic regression analyses to examine post-acute functional status and discharge disposition, respectively.

Results: The results indicated that older age, longer length of stay, lower Glasgow Coma Scale (GCS), higher Injury Severity Score (ISS), and individuals with tetraplegia had significantly lower motor functional score at discharge from an acute hospital. In addition, older age, individuals with public-sponsored insurance, longer length of stay, lower GCS, and higher ISS had significantly higher odds of being discharged to an institution, as compared to home. Individuals of Hispanic ethnicity, as compared to White, had lower odds of being discharged to an institution.

Conclusions: The regression models developed in this study were able to better classify discharge destinations compared to the functional outcomes at discharge from the acute hospital. Further research is necessary to determine how these factors and their associations vary nationally across the US, which have the potential to inform trauma and acute care post-SCI.

If the research was published, a reference to the journal.

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Title: Hemodynamic Deterioration in Interhospital Transfer for Trauma

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Objectives: Caring for injured patients in an integrated trauma system relies on interhospital transfer to optimize triage, but the decision to transfer must account for the potential impact on timing and availability of care. In this state-wide study, we evaluated physiological stability before and after transfer with the hypothesis that patients whose hemodynamics deteriorated between hospitals would be at risk for adverse outcomes.

Methods: We collected data on all patients transferred into Pennsylvania trauma centers from the Pennsylvania Trauma Outcomes Study registry, 2011-18. Patients were included if they had heart rate [HR] ≤ 100 and systolic blood pressure [SBP] ≥ 100 at presentation to the referring hospital and were transferred within 24 hours (Figure 1). Hemodynamic deterioration (HDD) was defined as admitting HR > 100 or SBP < 100 at the receiving center, with a deterioration of > 10 points. We compared demographics, injury characteristics, management, and outcomes between HDD patients and those who remained stable.

Results: Of 52,919 patients who were hemodynamically stable on presentation to a referring facility, 5,316 (10.0%) had HDD. HDD patients were more often moderate-severely injured (ISS > 9 ; 45.9% vs. 39.1%, $p<0.001$), or injured by motor vehicle collision (23.7% vs. 17.0%, $p<0.001$) or gunshot wound (2.1% vs 1.3%, $p<0.001$). HDD patients had fewer head injuries and more torso and extremity injuries. After transfer, HDD patients were more likely to receive blood transfusions (3.0% vs. 0.4%, $p<0.001$), go directly to surgery or interventional radiology (9.2% vs. 6.2%, $p<0.001$). Outcomes are shown in Figure 2.

Conclusion: Interhospital transfers are necessary to optimize trauma care, but 1 in 10 transferred patients deteriorated hemodynamically between hospitals. Careful attention to triage destination, pre-transfer management, and patient selection is needed to mitigate the risks associated with delays in care.

Figure 1: Flowchart of Hemodynamic Stability in Transfer Patients

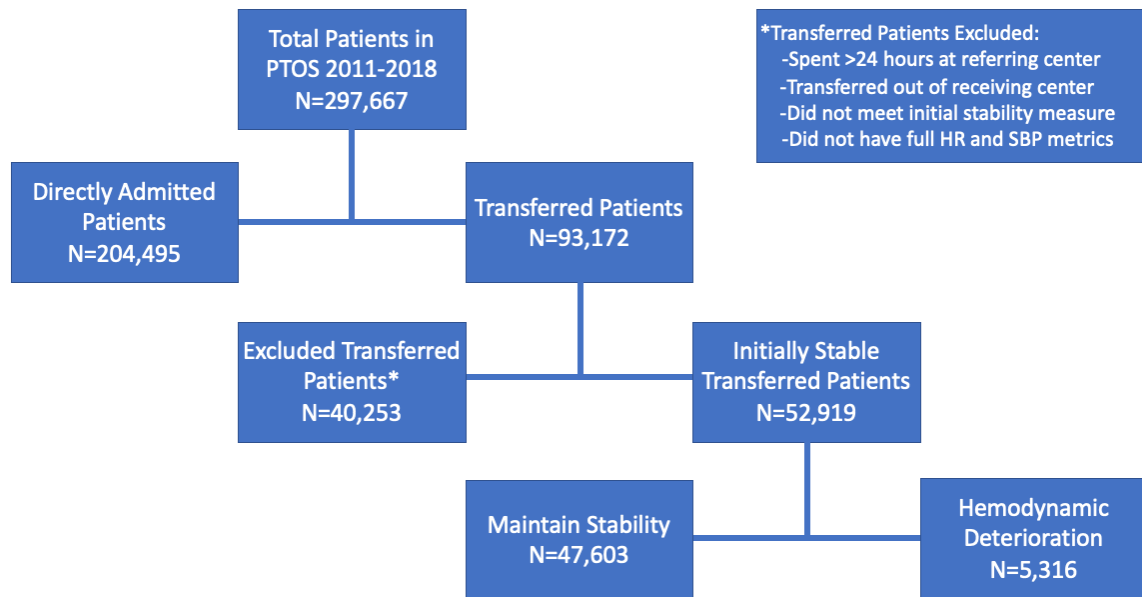
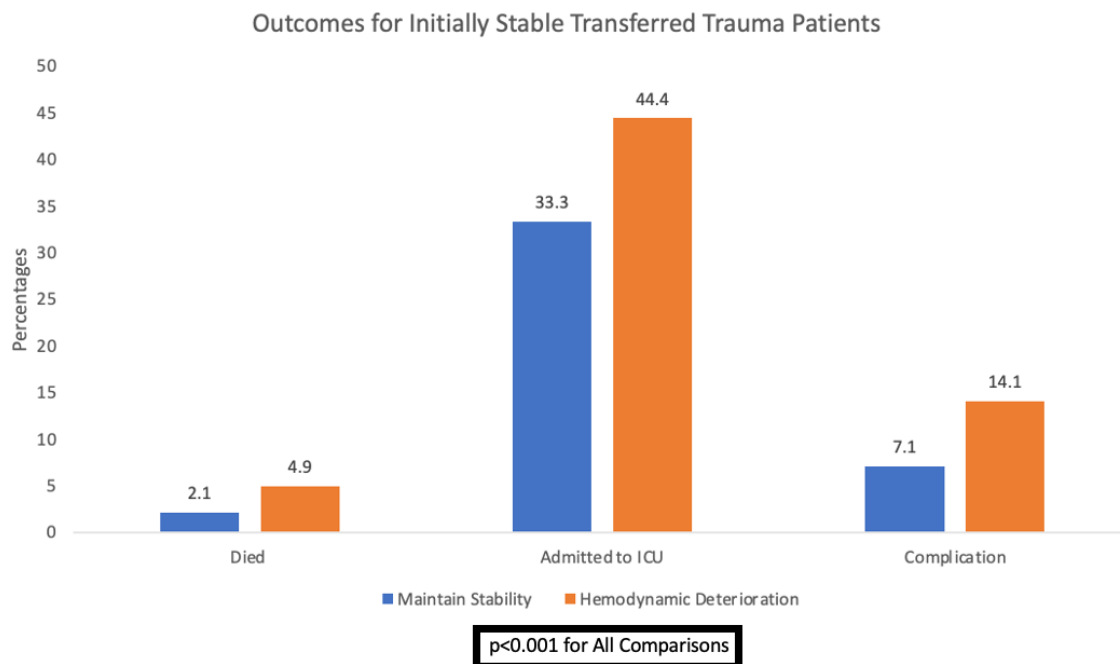


Figure 2: Outcomes for Initially Stable Transferred Trauma Patients



The Effect of COVID-19 on Adult Traumatic Orthopaedic Injuries: A Database Study

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Background: It is unknown if the COVID-19 stay-at-home order and change in population behaviors during this time has changed the number and characteristics of injuries seen at United States trauma centers during the pandemic. This study compares orthopaedic injuries, procedures, and hospital outcomes of patients presenting to trauma centers in Pennsylvania before and during the COVID-19 pandemic.

Methods: A retrospective review of adult patients presenting to hospitals with Pennsylvania Trauma Systems Foundation (PTSF) designations was performed. All patients 18 years of age and older who presented with orthopaedic injuries were included. Demographic information, injury and hospital stay details, and mortality were reviewed. Data were compared between the cohorts of patients presenting during April 2020 (COVID cohort) and April 2017, April 2018, and April 2019 (pre-COVID cohort).

Results: Overall, 14,858 patients who presented with traumatic injuries were reviewed, and 9427 patients were included in this study. There was no difference in location at which injuries were sustained ($p=0.11$) or injury mechanism ($p=0.40$) between cohorts. There were fewer orthopaedic injuries (4868 vs. 6603 yearly mean) in the COVID cohort which led to fewer procedures (1763 vs. 2329 yearly mean). The COVID cohort had a significantly shorter mean hospital length of stay compared to the pre-COVID cohort (4.7 days versus 5.2 days, $p=0.01$). A higher mortality rate was seen in the COVID cohort ($n=115$, 6.1%) compared to the pre-COVID cohort ($n=305$, 4.0%; $p<0.01$).

Discussion: The characteristics of orthopedic injuries sustained by patients presenting to trauma centers during the COVID pandemic were not different from prior to the pandemic. However, there were decreases in the number of orthopedic injuries and procedures and a 50% increase in mortality seen in these patients during the pandemic. Resources should be appropriately marshalled to prevent rises in-hospital mortality for patients with orthopedic trauma treated during a pandemic.

Level of Evidence: Level III

Title: A Statewide Analysis on the Origins Of De Novo Pulmonary Embolism (DNPE) In Trauma Patients: Does The Liver Play A Role?

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This research is an original work and has not been published previously.

Objective: Over the last decade the concept of de novo pulmonary embolism (DNPE), or pulmonary embolism (PE) independent of a deep vein thrombosis (DVT), has been realized, especially in trauma patients. Although the pathophysiology of DNPE remains unclear, most surmise that it stems from local inflammatory changes in the lungs or direct injury to pulmonary vasculature. Considering the anatomic relationship between the liver and the pulmonary vasculature, we hypothesize that liver injury may play an important role in DNPE formation. The purpose of our study was to compare the relationship between hepatic and lung injury to DNPE.

Methods: A retrospective chart review from January 2010 to December 2019 identified all blunt and penetrating trauma patients in the Pennsylvania Trauma Outcome Study (PTOS) database. Patients were divided and compared based on whether or not they suffered a liver or lung injury. Our primary outcome was the incidence of DNPE, defined as the incidence of PE without DVT. In a separate analysis, multivariate regression was used to identify independent risk factors for DNPE formation.

Results: In total, we identified 381,676 patients. Compared to non-liver injury patients, liver-

injury patients had a higher incidence of DNPE (1.3% vs. 0.3%, $P < .05$). Compared to non-lung injury patients, lung-injury patients had a higher incidence of DNPE (1.0% vs 0.3%, $P < .05$). Compared to non-DNPE patients, DNPE patients had a higher incidence of liver injury (8.9% vs. 2.4%, $P < .05$) and lung injury (18.5% vs. 6.4%, $P < .05$). On multivariate analysis, liver injury (OR 1.7), lung injury (OR 1.6), male gender (OR 1.2), and Injury Severity Score >25 (OR 3.3) were all independent predictors of DNPE.

Conclusion: Our data suggests that both liver injury and lung injury are independently associated with DNPE formation. We propose a novel theory, expanding on the lung-centered hypothesis for the pathophysiology of DNPE. Considering the direct anatomic relationship of the liver to the pulmonary vasculature, the local hypercoagulable, inflammatory, and thromboembolic effects of liver trauma may also promote DNPE formation.

Table 1: Incidence of PE, DVT, and DNPE in Liver and Lung Injury Patients

	Liver Injury (N = 9,251)	No Liver Injury (N = 372,425)
No. (%) PE	155 (1.7%)	1,605 (0.4%)
No. (%) DVT	303 (3.3%)	3,283 (0.9%)
No. (%) DNPE	123 (1.3%)	1,257 (0.3%)
	Lung Injury (N = 24,438)	No Lung Injury (N = 357,238)
No. (%) PE	345 (1.4%)	1,415 (0.4%)
No. (%) DVT	701 (2.9%)	2,885 (0.8%)
No. (%) DNPE	255 (1.0%)	1,125 (0.3%)

Table 2: Multivariable Regression Analysis for Predictors of DNPE

Variable	Significance	OR	95% CI
Injury Severity Score > 25	<0.001	3.27	2.79-3.84
Injury to liver	<0.001	1.67	1.35-2.06
Injury to lung	<0.001	1.62	1.38-1.89
Gender, male	0.004	1.19	1.06-1.35