A Retrospective Study of Disparities in an Academic Ophthalmic Emergency Department

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Abstract

Purpose Emergency medicine is a common access point to health care; disparities in this care by demographic characteristics, including race and ethnicity, may affect outcomes. The Massachusetts Eye and Ear (MEE) Emergency Department (ED) is a subspecialty emergency department; data from this site can be utilized to better understand social determinants of quality ophthalmic care.

Design This is a retrospective cross sectional cohort study in the MEE ED examining patient visits from June 1, 2016 to June 30, 2019.

Methods Using the electronic medical record system, all unique visits were identified between June 1, 2016 and June 30, 2019 (inclusive); patient demographics (sex, race, ethnicity [Hispanic vs. non-Hispanic], primary care provider [PCP] status, insurance type, zip code, primary language), date of visit, triage category and outcomes (final diagnosis, visit duration, and next visit at MEE within 3 months of the ED visit) were collected. Kaplan-Meier plots were used to visualize likelihood of follow-up visit to MEE for urgent patients based on demographics. Multivariate linear regression was used to examine factors affecting visit durations, as stratified by urgency, and Cox proportional hazards regression was used to establish hazard ratios for next visit to MEE.

Results Of the 46,248 ophthalmology ED initial visits, only triage status, season of visit, out-of-state residency, Medicare coverage, and Medicaid coverage led to statistically significant differences in visit durations for urgent visits compared with the respective reference groups. Similar trends persisted within the non-urgent visit cohort for visit durations. Residency, insurance coverage, season of visit, race, PCP status, and sex were identified as statistically significant predictors of the likelihood of a follow-up visit.

Conclusion Data from an ophthalmic emergency department suggest that demographic factors do impact patient visit duration and time to follow-up visit. These findings suggest a continued need for attention to social determinants of health and equitable care of patients within ophthalmology.

Keywords
► social determinants of health
► ophthalmic emergency room
► disparities
► equity

Emergency rooms are increasingly used as an access point for health care, often when patients do not have adequate access to primary care.[1–5] Studies suggest that the proportion of adult Americans with an identified source of primary care has decreased slightly in recent years, declining from 77% in 2002 to 75% in 2015.[3] Depending on the method of categorization, emergency room visits can be determined as "nonurgent" 4.8 to 90% of the time, with a median of 32%.[6] This may suggest a lack of understanding of the severity of symptoms in addition to a lack of access to outpatient care. Frequent, repeated, ED visits are common in patients with complex medical and psychosocial histories but are also seen among patients without these histories.[7,8]

One consequence of frequent ED use can be long wait times and visit durations; in the United States the average ED visit length is 4.12 hours.[9,10] In a study of hospitals nationwide conducted in 2006, the majority of hospitals failed to comply with ED wait times recommended on a four-level triage scale (emergent, urgent, semi-urgent, non-urgent) by the National Quality Forum, a national not-for-profit, nonpartisan organization.[11] Literature regarding the potential for demographic factors to influence triage decisions and health care in the ED setting is varied. Despite some research refuting the role of bias in clinician decision-making at triage, other studies do suggest that demographic factors can lead to disparities in care in the ED setting.[12–20]

The Massachusetts Eye and Ear (MEE) Emergency Department (ED) is a subspecialty emergency department open for ophthalmic care 24 hours a day 7 days a week, and is one of four ophthalmology-specific emergency departments in the United States. Patients present from throughout New England and are treated regardless of insurance status. Internal quality metrics, published in an annual MEE Quality & Outcomes report, show that there were 15,997 initial and 1,797 follow-up visits to the MEE ED in 2019; the top 20 urgent diagnoses represented 4,193, or 26.2% of initial visits as determined by expert opinion (►Table 1).[21] In 2019 the average visit duration in the MEE ED was 2.9 hours, which is well below the national average. Patients in the MEE ED are offered follow-up visits if needed for subsequent clinical care; this is usually in the ambulatory setting but can take place in the ED if ambulatory appointments are not available. In this paper, we examine the demographics of patients in this specialty emergency department, and the effect of particular demographic factors on visit duration and follow-up visits.

Methods

Ophthalmology emergency department initial visits at Mass Eye and Ear from June 1, 2016 to June 30, 2019 were extracted from the electronic medical record (EMR). Fields that were extracted for each ED visit included: sex, race, ethnicity (Hispanic vs. non-Hispanic), primary care provider (PCP) status, insurance type, zip code, primary language, triage category, final diagnosis, and visit duration. The date of the next ophthalmology visit (surgical visit, clinical visit, or repeat ED visit) to MEE, following the original ED visit, was also extracted. The Massachusetts Eye and Ear Institutional

Table 1 Urgent ophthalmic diagnosis

Abscess of eyelid	Keratoconus
Anisocoria	Laceration of eyelid
Burn	Macular hole
Canaliculitis	Optic neuritis
Central serous retinopathy	Other ocular foreign body
Contusion of eye	Orbital fracture
Corneal foreign body	Orbital inflammation
Corneal ulcer	Papilledema
Dacryoadenitis	Retina artery occlusion
Dacryocystitis	Retinal break
Diplopia	Retinal detachment
Dislocation of lens	Retinal hemorrhage
Endophthalmitis	Retinal vascular occlusion
Glaucoma	Retinal vein occlusion
Globe trauma	Scleritis
Hypopyon	Uveitis
Iridocyclitis	Visual field defect
Iridodialysis	Vitreous hemorrhage
Keratitis	

Review Board deemed this research exempt. Our study adheres to the tenets of the Declaration of Helsinki. Obtaining informed consent was not required due to the retrospective nature of our study.

Race was self-reported by patients upon first registration to MEE. The distinct options available in the EMR for race during the study period were White, American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or Other Pacific Islander, and Hispanic. There was an additional field that designated patients as Hispanic or Not Hispanic ethnicity, which was also self-reported. If a patient was unable to provide this information or declined to report, it was marked as "unknown." In addition, any blank field for race or Hispanic versus non-Hispanic ethnicity was marked as "unknown" in the dataset.

Insurance type was categorized into seven categories: private, accidental, CHIP, government, Medicaid, Medicare, other, and no insurance. All 259 unique insurances were identified and categorized into these eight categories. Insurances that contained key phrases of "Medicare," "MassHealth," or "Medicaid" were categorized into "Medicare," "government," and "Medicaid," respectively. Any medical plan containing the phrase "Children Medical Security" was categorized as CHIP. Insurance sponsored by municipalities, state, federal, and military organizations were considered to be government issued plans. Any policies that were under the jurisdiction of worker's compensation or through auto-policies were recognized as accidental insurances. Private insurance was then identified and reviewed to avoid conflicts with the other classifications. Insurance policies that did not belong to any of the aforementioned categories

were categorized as "other." This included international policies, student insurances, and other generic medical insurances. Fields that had no insurance were considered to be uninsured. This method was based on other studies using a similar method for categorization of insurance types.[10,15,20]

Zip codes were bucketed into the respective Massachusetts counties using open source data. Any patients that did not have an in-state zip code were categorized as "out of state."

Visit duration was defined as the difference between the time of initial check-in at MEE ED and the discharge time, which were both marked in the EMR.

Triage category was determined by a nurse at presentation using a pre-determined list of chief complaints. Triage Category 1 was described as "Emergency," Category 2 as "Urgent" and Category 3 as "non-urgent." This triage was used to expedite certain patients to the attention of a physician.

The final billing diagnosis was categorized as urgent or non-urgent using a method established for the annual MEE Quality and Outcomes report.[21] This differentiation was based on clinical expertise of a reviewing clinician team; potential urgent diagnoses included abscess of eyelid, anisocoria, burn, canaliculitis, central serous retinopathy, contusion of eye, corneal foreign body, corneal ulcer, dacryoadenitis, dacryocystitis, diplopia, dislocation of lens, endophthalmitis, glaucoma, globe trauma, hypopyon, iridocyclitis, iridodialysis, keratitis, keratoconus, laceration of eyelid, macular hole, optic neuritis, other ocular foreign body, orbital fracture, orbital inflammation, papilledema, retinal artery occlusion, retinal break, retinal detachment, retinal hemorrhage, retinal vascular occlusion, retinal vein occlusion, scleritis, uveitis, visual field defect, and vitreous hemorrhage. Diagnoses that did not fall in the above categories were considered non-urgent.

Subsequent visit was defined as any ophthalmology visit to MEE, starting from the day after presentation up to 3 months after the anchor ED visit. Same day visits were not included, as they were considered to be part of the episodes of emergency medical care. These subsequent visits included subspecialty ophthalmology clinic visits, another ED visit, a surgery, or an inpatient visit. After 3 months, a repeat ED visit by a patient was considered a new initial ED visit.

Descriptive statistics were calculated for all baseline covariates and demographic variables of interest. Multivariate linear regression models were fit to examine factors affecting ED visit durations, as stratified by urgency. Both a fully saturated model and a final model were fit for each urgency status. Final models were determined using automated stepwise selection utilizing Akaike's Information Criterion (AIC).[22] Kaplan Meier (KM) curves were fit to the data to model the probability of survival as defined as time to follow-up visit at MEE for urgent patients based on the state of residency, biological sex, and primary language. Log-rank tests were conducted to compare survival curves on each KM plot. Cox proportional hazards (PHs) models were fit to

model the hazard of having another visit with MEE within 3 months after an anchor ED visit, stratified by urgency of the visit. Robust standard errors were used in all Cox PH models to relax the assumption of PH across all covariates of interest.[23,24] All analyses were conducted using R, version 4.0.0.

Results

There were a total of 46,248 initial ophthalmology ED visits at Mass Eye and Ear from June 1 2016 to June 31 2019. ►**Table 2** contains case level demographic data for these visits. No table findings from this table include: 29.7% of visits involved a patient with no listed PCP, 20.16% of visits were by non-White patients, 9.49% of visits were with patients who did not report English as their primary language, 13.21% of visits were by patients who lived outside of Massachusetts, and 27.64% of visits were associated with an urgent final primary diagnosis.

►**Table 3** presents the full model for visit durations and ►**Table 4** presents the final statistical model which includes variables for which a statistically significant difference was observed. Mean visit durations across demographic variables and subsequent β coefficients and p-values stratified by urgency are shown.

The average visit duration for in-state patients was shorter than the average visit duration for out-of-state patients, holding all other variables constant. This was true for both urgent and non-urgent visits ($\beta - 138.73$, $p < 0.0001$; $\beta - 47.26$, $p < 0.0001$). Insurance status also impacted visit length. Patients with Medicaid had significantly longer visits for both urgent and non-urgent diagnoses (β 73.57, $p = 0.0022$; β 28.16, $p = 0.0003$.). Patients with Medicare also had significantly longer visits for both urgent and non-urgent diagnoses (β 105.29, $p < 0.0001$; β 38.10, $p < 0.0001$.). In addition, patients without insurance had longer visits, but only for non-urgent diagnoses (β 31.51, $p = 0.0025$.). Both urgent and non-urgent visits were significantly shorter in Winter, Spring, and Summer compared with Fall. Both urgent and non-urgent visits were significantly shorter for triage categories two and three compared with triage category one.

No significant differences in visit durations were demonstrated based on race, ethnicity (Hispanic vs. non-Hispanic), sex, PCP status, or primary language categories among urgent or non-urgent visits (►**Table 3**).

►**Table 5** presents hazard ratios across demographic variables for the probability of having another visit with MEE within 3 months after an anchor ED visit, stratified by urgency of the visit. For urgent visits, out-of-state residency, Black race, and four types of insurance (accidental, CHIP, Medicaid, and Medicare) significantly decreased the chance of having a follow-up appointment compared with in-state residency, White race, and private insurance, respectively. For non-urgent visits, out-of-state residency, three insurance types (Accidental, CHIP, Medicare), season of visit (Winter and Spring), association with a PCP and female sex significantly decreased the chance of having a follow-up appointment when compared with in-state residency, private

Table 2 Case level demographics of MEE Ophthalmology ED visits from June 1, 2016 to June 31, 2019, $n = 46,248$

Demographic	Count (%)
Biological sex	
Male	24,507 (52.99)
Female	21,739 (47.01)
Unknown	2 (0.00)
Race[a]	
American Indian	85 (0.21)
Asian	2,958 (7.19)
Black	2,644 (11.32)
Hawaiian	129 (0.31)
Hispanic	461 (1.12)
White	32,832 (79.84)
Unknown	5,128 (11.10)
Ethnicity (Hispanic vs. Non-Hispanic)[a]	
Hispanic	4,515 (9.83)
Non-Hispanic	41,398 (90.17)
Unknown	335 (0.72)
Primary Language	
English	41,147 (90.51)
Non English	4,316 (9.49)
Unknown	785 (1.70)
In state vs. Out of state	
In state	40,141 (86.80)
Out of state	6,107 (13.21)
Listed PCP	
Yes	32,503 (70.28)
No	13,745 (29.72)
Unknown	1,334 (2.88)
Primary Insurance	
Accidental	919 (2.13)
CHIP	44 (0.10)
Government	1,174 (2.72)
Medicaid	6,131 (14.19)
Medicare	10,020 (23.20)
Private	24,617 (57.00)
Other	285 (0.66)
No insurance	3,058 (6.61)
Final diagnosis	
Urgent	12,782 (27.64)
Non-urgent	33,466 (72.36)
Triage category	
1 (Emergency)	1,094 (2.37)
2 (Urgent)	33,720 (72.92)

Table 2 (Continued)

Demographic	Count (%)
3 (Non-urgent)	11,425 (24.71)
Unknown	9 (0.02)

Abbreviations: CHIP, Children's Health Insurance Program; PCP, primary care physician.
[a]Self-reported by patients upon registering with staff members trained in asking how patients identify in terms of their race and ethnicity (Hispanic vs. non-Hispanic).

insurance, fall season, no association with a provider and male sex, respectively. Primary language (English vs. non-English) did not affect the chance of having a follow-up appointment either for urgent or non-urgent visits. Ethnicity (Hispanic vs. non-Hispanic) similarly did not affect the chance of having a follow-up appointment either for urgent or non-urgent visits.

The Kaplan-Meier (KM) plots (►**Fig. 1**) present survival analysis for variables with statistically significant *p*-values from the log-rank test comparing survival probability of having a follow-up after initial ED visit over time. For non-urgent visits, there is a statistically significant difference between the survival pattern of having another visit at MEE in the 3 months following their ED visit comparing males to females (►**Fig. 1a**). For urgent visits, there is a statistically significant difference between this survival pattern comparing in state residents to out of state residents (►**Fig. 1b**), comparing patients where English is their primary language to non-English speaking patients (►**Fig. 1c**), non-Hispanic patients to Hispanic patients (►**Fig. 1d**), and Black patients to White patients (►**Fig. 1e**). The *p*-value depicted on the KM plots is derived from the log-rank test, which is a non-parametric test that has been conducted on a single variable of interest, whereas the *p*-values from the Cox PH regression models are derived from a semi-parametric test of the survival function of multiple covariates at once. That is, any particular covariate's univariate statistical significance from preliminary KM plot results may change or shift, depending on its effect on survival after adjusting for all other covariates of interest in the Cox PH regression model, especially if the assumption of PH is violated for the covariate in question.

Discussion

Demographic data from patients seeking urgent care at an ophthalmic emergency room can potentially serve as a window into social determinants of care throughout the field. This study examines many of those factors and their effect on the visits durations and likelihood to follow-up within the same hospital system. In doing so we identify potential disparities in care that can be further investigated and addressed to improve equity of care and outcomes.

Overall, this study demonstrates that, in our population, race, ethnicity (Hispanic vs. non-Hispanic), sex, and primary language did not affect the length of a patient's ED visit for an

Table 3 Full MEE Ophthalmology ED visit durations multiple linear regression model, with all variables regardless of statistical significance (supplemental section)

Demographic[a]	Urgent visits			Non-urgent visits		
	Mean visit duration min, (SD)	β [95% CI]	p	Mean visit duration min, (SD)	β [95% CI]	p
Residency						
Out of state	471.78 (1,156.03)	–	–	230.25 (693.40)	–	–
In state	298.81 (704.88)	−137.44 [−176.52, −98.36]	<0.0001	182.76 (346.12)	−47.97 [−62.54, −33.41]	<0.0001
Primary insurance						
Private	277.13 (668.30)	–	–	173.20 (264.59)	–	–
Accidental	428.54 (853.67)	68.69 [−18.01, 155.39]	0.1204	179.12 (260.65)	−10.37 [−50.10, 29.36]	0.6091
CHIP	249.62 (99.66)	−129.46 [−1,005.66, 746.75]	0.7721	193.67 (70.37)	17.41 [−202.82, 237.64]	0.8769
Government	383.68 (1,122.60)	62.20 [−28.99, 153.39]	0.1813	183.26 (270.88)	8.326 [−22.82, 39.47]	0.6002
Medicaid	357.93 (831.96)	71.28 [22.64, 119.92]	0.0041	198.30 (465.42)	27.08 [11.06, 43.10]	0.0009
Medicare	433.62 (1,070.02)	92.46 [46.83, 138.09]	0.0001	217.16 (526.33)	37.29 [22.97, 51.61]	<0.0001
Other	213.73 (128.00)	−25.11 [−244.98, 194.77]	0.8229	177.01 (132.44)	−5.67 [−72.31, 60.97]	0.8675
No insurance	321.06 (614.66)	−8.33 [−69.04, 52.37]	0.7878	210.65 (773.00)	31.47 [10.67, 52.26]	0.003
Season of visit						
Fall	385.17 (1,025.61)	–	–	209.73 (500.58)	–	–
Spring	302.24 (667.92)	−77.59 [−118.38, −36.80]	0.0002	174.93 (348.56)	−34.72 [−47.97, −21.48]	<0.0001
Summer	322.58 (699.87)	−55.61 [−95.73, −15.50]	0.0066	189.05 (383.32)	−21.48 [−34.50, −8.45]	0.0012
Winter	308.23 (800.37)	−58.34 [−100.78, −15.90]	0.0071	181.53 (381.93)	−27.45 [−41.42, −13.47]	0.0001
Race[a]						
White	338.06 (830.44)	–	–	189.01 (405.82)	–	–
American Indian	761.50 (2,336.11)	473.75 [94.19, 853.30]	0.0144	155.61 (110.29)	−22.02 [−123.70, 79.66]	0.6712
Asian	249.11 (409.12)	−41.24 [−103.80, 21.33]	0.1964	175.34 (356.11)	−4.17 [−22.79, 14.44]	0.6603
Black	312.43 (785.46)	1.31 [−46.46, 49.09]	0.957	196.63 (455.10)	9.25 [−6.06, 24.56]	0.2365
Hawaiian	251.51 (234.91)	−75.80 [−351.79, 200.18]	0.5903	164.96 (82.27)	−27.57 [−110.35, 55.21]	0.5139
Hispanic	260.60 (381.22)	−83.97 [−242.89, 74.94]	0.3003	187.38 (309.03)	−6.86 [−55.39, 41.66]	0.7816
Ethnicity(Hispanic vs. non-Hispanic)[a]						
Non-Hispanic	329.31 (808.27)	–	–	188.49 (408.82)	–	–

(*Continued*)

Table 3 (*Continued*)

Demographic[a]	Urgent visits			Non-urgent visits		
	Mean visit duration min, (SD)	β [95% CI]	*p*	Mean visit duration min, (SD)	β [95% CI]	*p*
Hispanic	331.12 (754.56)	19.54 [−59.37, 98.45]	0.6274	192.49 (347.10)	11.51 [−14.25, 37.27]	0.3811
Listed PCP						
No	348.09 (767.01)	–	–	192.03 (458.25)	–	–
Yes	321.05 (822.61)	0.60 [−32.55, 33.75]	0.9717	187.61 (388.33)	1.50 [−10.25, 13.25]	0.8025
Biological sex						
Male	339.06 (768.70)	–	–	190.36 (423.28)	–	–
Female	317.35 (849.92)	−0.46 [−29.97, 29.05]	0.9757	187.40 (392.82)	−1.33 [−10.93, 8.27]	0.7856
Primary language						
English	328.05 (806.34)	–	–	188.42 (415.54)	–	–
Non-English	352.67 (799.07)	18.07 [−52.02, 88.15]	0.6134	192.35 (224.16)	−6.04 [−27.43, 15.35]	0.5799
Triage level						
1	1,418.81 (2,057.78)	–	–	389.27 (767.42)	–	–
2	290.82 (682.74)	−1,096.13 [1,165.16, −1,027.11]	<0.0001	200.27 (453.60)	−181.22 [−220.47, −141.98]	<0.0001
3	186.81 (290.77)	−1,191.06 [−1,268.95, −1,113.16]	<0.0001	150.12 (200.25)	−181.22 [−220.47, −141.98]	<0.0001

[a]Self reported by patients upon registering with staff members specifically trained in asking how patients identify in terms of their race.

ophthalmic concern, regardless of urgency of the diagnosis at that visit. Patient were more likely to have longer visits if designated by the triage nurse to be Triage Category 1 urgency. This aligns with the intention of the triage system, which identifies patients with more acute and complex problems. Patients were also more likely to have longer visits if they presented from out-of-state for both urgent and non-urgent diagnoses; this may be due to patients presenting with more complex problems, or seeking second opinions, when traveling from further distances. Finally, possession of several types of non-private insurance (Accidental, CHIP, Medicare and Medicaid for urgent visits and Accidental, CHP and Medicaid for urgent visits) was associated with longer visit durations. There is a need for further investigation into this. This may suggest that patients on these plans have more complex eye problems requiring more extensive care. However, this may also be due to unconscious bias on the behalf of health care providers to prioritize or treat well-insured patients more expeditiously.

Patients presenting to the MEE ED are often offered follow-up depending on the nature of their problem. Follow-up at MEE is not offered uniformly, as patients may have diagnoses that do not require it or may have their own eye care physicians outside of our system, with whom they choose to pursue subsequent care. Follow-ups at MEE can take place in a specialized "ED follow-up" clinic, in a general eye clinic, in a specialty clinic, or in the ED as a "follow-up" if none of these appointments are available. Because ED visits can result in surgical intervention, encounters in the operating room subsequent to an anchor ED visit were also considered to be follow-up. Out-of-state residency decreased the chance of follow-up for both urgent and non-urgent visits; this is likely because of barriers to travel and patients electing to follow-up closer to home. This may suggest the importance of expansion of specialty care into the community to improve accessibility. Again, insurance type impacted the chance of follow-up visit for both urgent and non-urgent diagnoses; this requires further investigation to determine barriers to accessing care in this population. Despite initial differences in time to follow-up suggested in single variable tests and demonstrated in the KM plots, there was ultimately no difference in time to follow-up based on Hispanic versus non-Hispanic ethnicity or based on primary language when controlling for other variables. This was likely due to co-linearity of these two variables, with race. There were two findings in the follow-up visit analysis which can point to significant differences in care due to social determinants of health. Compared with White patients, Black patients had a

Table 4 Multiple linear regression models after stepwise selection for ED visit durations stratified by urgency of visit, with mean visit durations, standard deviations, β coefficients, and p-values for all categories with variables with p-value <0.05

Demographic[a]	Mean visit duration Minutes (SD)	Urgent visits β [95% CI]	p	Mean visit duration Minutes (SD)	Non-urgent visits β [95% CI]	p
Residency						
Out of state	471.78 (1,156.03)	–	–	230.25 (693.40)	–	–
In state	298.81 (704.88)	−138.73 [−176.97, −100.49]	<0.0001	182.76 (346.12)	−47.26 [−61.69, −32.92]	<0.0001
Insurance						
Private	277.13 (668.30)	–	–	173.20 (264.59)	–	–
Accidental	428.54 (853.67)	67.97 [−17.86, 153.80]	0.1206	179.12 (260.65)	−9.14 [−48.61, 30.32]	0.6497
CHIP	249.62 (99.66)	25.86 [−840.21, 891.92]	0.9533	193.67 (70.37)	18.84 [−201.05, 238.73]	0.8666
Government	383.68 (1,122.60)	68.00 [−22.68, 158.68]	0.1416	183.26 (270.88)	8.93 [−22.10, 39.96]	0.5727
Medicaid	357.93 (831.96)	73.57 [26.45, 120.70]	0.0022	198.30 (465.42)	28.16 [12.75, 43.56]	0.0003
Medicare	433.62 (1,070.02)	105.29 [68.21, 142.36]	<0.0001	217.16 (526.33)	38.10 [23.85, 52.34]	<0.0001
Other	213.73 (128.00)	−5.32 [−64.80, 54.15]	0.8607	177.01 (132.44)	−8.26 [−74.50, 57.99]	0.807
No insurance	321.06 (614.66)	−45.67 [−263.05, 171.70]	0.6804	210.65 (773.00)	31.51 [11.06, 51.97]	0.0025
Season of visit						
Fall	385.17 (1025.61)	–	–	209.73 (500.58)	–	–
Spring	302.24 (667.92)	−77.97 [−118.69, −37.25]	0.0002	174.93 (348.56)	−34.40 [−47.63, −21.17]	<0.0001
Summer	322.58 (699.87)	−57.83 [−97.89, −17.78]	0.0047	189.05 (383.32)	−21.27 [−34.29, −8.24]	0.0014
Winter	308.23 (800.37)	−59.17 [−101.57, −16.76]	0.0063	181.53 (381.93)	−27.25 [−41.23, −13.28]	0.0001
Triage category						
1	1,418.81 (2,057.78)	–	–	389.27 (767.42)	–	–
2	290.82 (682.74)	−1,096.09 [−1,165.02, −1027.17]	<0.0001	200.27 (453.60)	−181.35 [−220.55, −142.16]	<0.0001
3	186.81 (290.77)	−1,192.41 [−1,270.11, −1,114.71]	<0.0001	150.12 (200.25)	−231.56 [−271.34, −191.78]	<0.0001

Abbreviation: CHIP, Children's Health Insurance Program.

[a]The demographics shown represent each of the covariates that were chosen via stepwise selection to be included in the final multiple linear regression model. Bold variables have a p-value <0.05 in the final dataset.

Table 5 Hazard ratios for time to next visit after initial ED visit, urgent and non-urgent, with hazard ratios and *p*-values for all variables with *p*-value <0.05

Demographic[a]	Urgent visits		Non-urgent visits	
	HR [95% CI]	*p*	HR [95% CI]	*p*
Residency				
In state	–	–	–	–
Out of state	0.91 [0.85, 0.97]	0.0037	0.94 [0.88, 0.99]	0.0266
Primary Insurance				
Private	–	–	–	–
Accidental	0.79 [0.67, 0.93]	0.0005	1.23 [1.06, 1.43]	0.0062
CHIP	1.67 [0.42, 6.70]	0.4696	9.55 [3.07, 29.71]	0.0001
Government	0.89 [0.76, 1.03]	0.1193	0.89 [0.79, 1.00]	0.0503
Medicaid	0.89 [0.82, 0.96]	0.0037	1.00 [0.95, 1.07]	0.8721
Medicare	0.92 [0.87, 0.98]	0.009	0.94 [0.91, 0.98]	0.0068
Other	1.33 [0.93, 1.92]	0.1212	1.18 [0.91, 1.55]	0.2175
No insurance	1.01 [0.91, 1.12]	0.8714	0.96 [0.88, 1.04]	0.3259
Season of visit				
Fall	–	–	–	–
Spring	1.05 [0.98, 1.12]	0.1928	1.05 [1.00, 1.11]	0.0375
Summer	1.02 [0.95, 1.09]	0.5793	0.98 [0.93, 1.03]	0.3542
Winter	1.01 [0.95, 1.09]	0.7035	1.09 [1.03, 1.15]	0.0011
Race				
White	–	–	–	–
American Indian	0.82 [0.41, 1.65]	0.5848	1.17 [0.78, 1.74]	0.4512
Asian	1.02 [0.93, 1.13]	0.6417	0.99 [0.92, 1.06]	0.6804
Black	0.91 [0.84, 0.98]	0.0143	1.02 [0.96, 1.07]	0.5792
Hawaiian	0.91 [0.58, 1.43]	0.6841	0.91 [0.68, 1.22]	0.5341
Hispanic	0.87 [0.68, 1.12]	0.2947	0.86 [0.72, 1.02]	0.0846
Ethnicity (Hispanic vs. non-Hispanic)				
Non-Hispanic	–	–	–	–
Hispanic	0.89 [0.78, 1.01]	0.0788	1.06 [0.97, 1.17]	0.2019
Listed PCP				
No	–	–	–	–
Yes	0.98 [0.93, 1.03]	0.417	0.82 [0.78, 0.86]	<0.0001
Biological sex				
Male	–	–	–	–
Female	1.03 [0.98, 1.08]	0.2581	0.90 [0.87, 0.93]	<0.0001
Primary Language				
English	–	–	–	–
Non-English	0.95 [0.85, 1.06]	0.3473	0.99 [0.92, 1.07]	0.8315

Abbreviation: CHIP, Children's Health Insurance Program.

significantly decreased chance of having a follow-up visit for urgent diagnoses. This was not found to be true for non-urgent diagnoses. Compared with male patients, female patients had a significantly decreased chance of having a follow-up visit for non-urgent diagnoses. These two findings merit further investigation into the cause of the disparities.

This could be due to patient preference, but also could be an evidence of unconscious bias in the process of offering follow-up visits to these patients. There could also be differences in the ability of different groups to return even if given an appointment. This may suggest a need for better oversight from a care coordination perspective to ensure that all
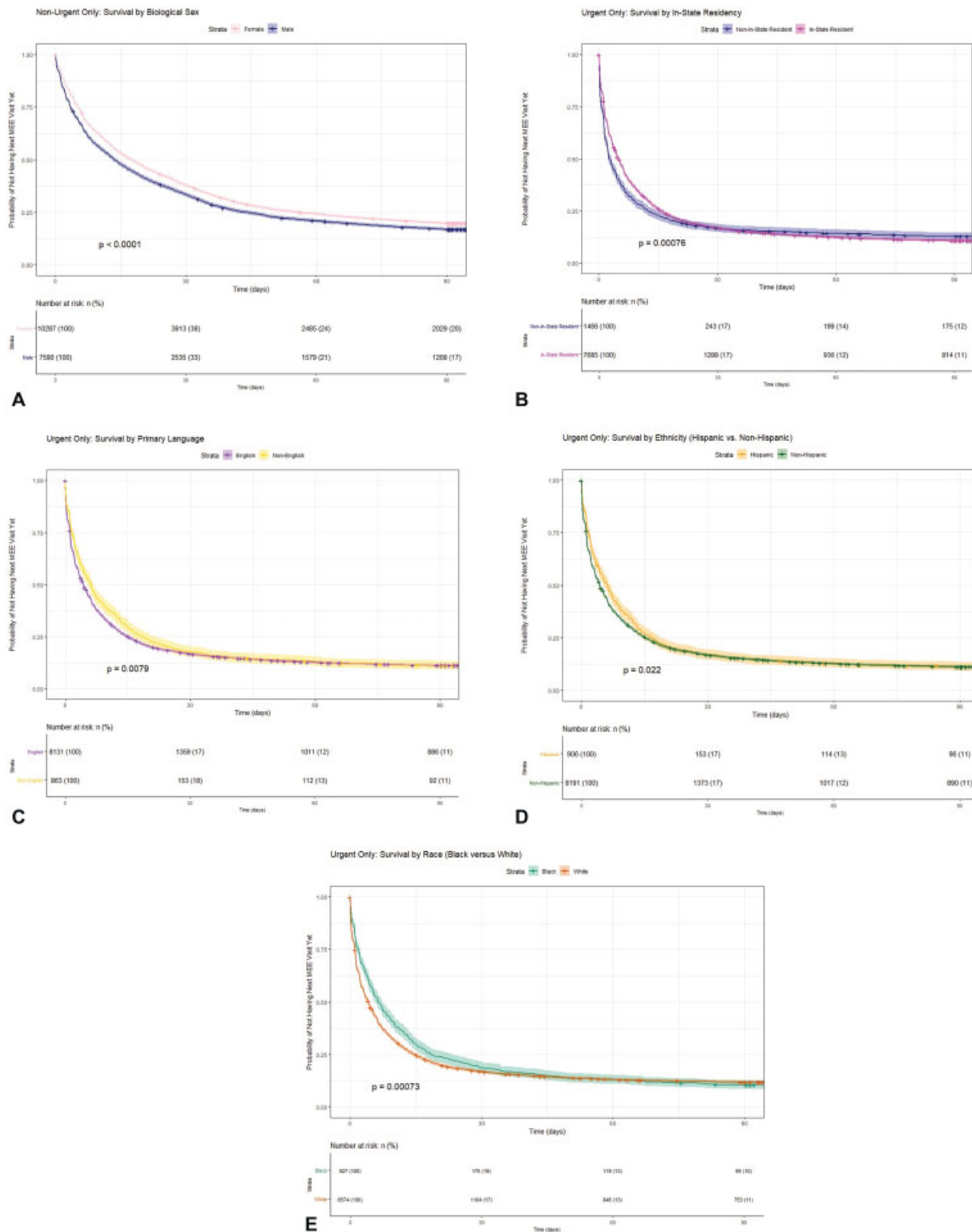
Fig. 1 Kaplan Meier plots for significant variables. (**A**) Survival analysis of continued care following non-urgent ED visits stratified by biological sex. (**B**) Survival analysis of continued care following urgent ED visits stratified by patient residency. (**C**) Survival analysis of continued care following urgent ED visits stratified by primary language. (**D**) Survival analysis of continued care following urgent ED visits stratified by ethnicity (Hispanic vs. non-Hispanic). (**E**) Survival analysis of continued care following urgent ED visits stratified by race (Black vs. White).

patients are offered and receive appropriate follow-up care after an ED visit.

This study was limited by the inability to accurately measure wait time rather than visit duration; we are unable to determine how much of the visit duration was spent in the waiting room compared with under care by a physician. Time stamping practices, although standardized, could also vary by staff member. In addition, we are unable to capture follow-up visits that did not occur within our system and so are only able to include patients who returned to seek care

at MEE. We are also unable to determine whether patients were offered follow-up visits and did not pursue them, or were not offered to them. We did not investigate whether follow-up appointments were scheduled but only whether patients attended a follow-up visit; patients may have been unable to attend scheduled follow-up visits due to various factors. Further investigation would better inform the determinants of these disparities in follow-up. Finally, the designation of urgent versus non-urgent diagnoses may not correlate with the urgency of the chief complaint; one chief complaint, such as floaters, could result in a non-urgent diagnosis, like vitreous syneresis, or an urgent diagnosis, like retinal detachment. Therefore, this designation as urgent or non-urgent diagnosis may not reflect on the necessity of the visit. Finally, the EMR did contain a field that comprised options for patient ethnicities; this field contained upwards of 100 ethnicities. We elected to use only a second field designating patients as Hispanic versus non-Hispanic for the ease of analysis but further research looking at a broader set of ethnicities in a larger dataset would be worthwhile.

In conclusion, this study models one way in which the field of ophthalmology can examine the social determinants of ophthalmic care, by examining the impact of various demographic factors on ED visit durations and completion of a follow-up visit. 79.84% of patients presenting with initial ED visits in this study were White, which does not reflect the overall demographic of the surrounding city of Boston which is 52.4% White but is closer to that of the state of Massachusetts which is 80.6% White.[25] This may suggest that our ED does not adequately serve the immediate surrounding population. Overall, findings were reassuring in that only patient residency and insurance states uniformly impacted these process metrics. However, race and sex did impact the likelihood of patient follow-up after an initial ED visit.

Issues of disparity in care based on demographic factors have become increasingly recognized across medicine. Disparities certainly exist as well in the field of ophthalmology and further studies identifying potential sources of this can lead to improvement both in process and potential outcomes of care.

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