BRIEF COMMUNICATION

Risk Factors for Hospitalization Among Patients with COVID-19 at a Community Ambulatory Clinic in Massachusetts During the Initial Pandemic Surge

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Abstract
Among patients with COVID-19 evaluated in outpatient settings, factors associated with hospitalization remain poorly understood. Multivariable regressions were used to assess sociodemographic and clinical factors associated with increased odds of hospitalization among patients with confirmed COVID-19 between March 18, 2020 through April 25, 2020 at a community-based outpatient clinic in Massachusetts. Older age, BMI ≥ 25, self-reported dizziness/lightheadedness, temperature ≥ 99.5°F, tachycardia, and oxygen saturation < 95% were associated with increased odds of hospitalization after adjustment for age, sex, and BMI. There was also an association between speaking Spanish as primary language and increased odds of hospitalization (compared to English, adjusted OR = 2.99 [95% CI 1.39, 6.39]). Speaking Portuguese as primary language was not associated with increased odds of hospitalization (compared to English, adjusted OR = 1.83 [0.78, 4.28]). In addition to several clinical risk factors established among inpatients, our study found that primarily speaking Spanish, but not Portuguese, was a marker of hospitalization risk among a diverse outpatient cohort of patients with COVID-19.

Keywords COVID-19 · Massachusetts · Risk factors · Health inequities · Immigrant health · Language · Ambulatory care

Introduction
Multiple studies have investigated the initial coronavirus disease (COVID-19) pandemic surge in eastern Massachusetts. Massachusetts’ first documented case of COVID-19 was February 1, 2020 and cases increased throughout March with the initial wave of COVID-19 peaking during the third week of April 2020 [1]. Massachusetts’ Governor Charlie Baker issued a “stay at home” advisory from March 23, 2020 to May 18, 2020.

Several studies have identified the disparate impact of COVID-19 among certain ethnic and racial groups in Massachusetts, in particular showing a disproportionate disease burden among Hispanic and Black patients [2–5]. One analysis of COVID-19 hospitalizations in Massachusetts found that Hispanic and Black individuals constituted a disproportionately higher proportions of COVID-19 hospitalizations compared to their representative proportions of the state’s population [5]. Another study of Massachusetts census data found increased COVID-19 mortality in areas with higher household crowding, rates of poverty, and racialized economic segregation; with lower mortality in neighborhoods with higher percentages of non-Hispanic white residents [4].

The structural factors underlying this disparity require further study and more systematic assessment, particularly in outpatient settings designed to care for COVID-19 patients. In the current study, we investigated sociodemographic and clinical factors associated with increased odds of hospitalization among outpatients with COVID-19 evaluated at a community-based clinic during the initial surge in Massachusetts from March to April 2020 [6]. At the time of the study, the clinic served as the sole ambulatory care setting for our safety net health care system which cares

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for more than 140,000 patients in Eastern Massachusetts. Among adults in our safety net healthcare system, English is the most common primary language (59%), followed by Portuguese (13%) and Spanish (10%).

**Methods**

Patients 18 years of age or older who had an initial visit from March 18, 2020 through April 25, 2020 at our ambulatory clinic and had a positive result of a nasopharyngeal swab for SARS-CoV-2 using the CDC 2019-Novel Coronavirus RT-PCR Diagnostic Panel kit were included in the analytic sample. Patients who were initially evaluated in the emergency department were excluded. Patients were considered hospitalized if they were admitted to any hospital, not limited to our network. Patients evaluated and discharged by emergency departments and patients hospitalized for childbirth were considered non-hospitalized for the purposes of our study. Demographic and clinical factors were evaluated for independent associations with risk of hospitalization within 30 days of initial clinic evaluation. Bivariate analyses as well as multivariable logistic regression models adjusting for age, sex and body mass index (BMI) were used to assess the association between each potential risk factor and hospitalization. This was determined to be a quality improvement study by the Cambridge Health Alliance institutional review board and informed consent was not required.

**Results**

A total of 1377 adult patients with symptoms consistent with COVID-19 were evaluated, of whom 188 were excluded (87 for visiting an emergency department since onset of their symptoms prior to their clinic visit, 100 who did not get nasopharyngeal testing, and 1 due to lost nasopharyngeal sample en route to the laboratory). Of the remaining 1189 patients, 460 (38.7%) had a positive SARS-CoV-2 result. Sixty-four of the 460 patients were hospitalized within 30 days of respiratory clinic evaluation; two patients were hospitalized for childbirth and, therefore, considered non-hospitalized for the purposes of our study.

Demographic and clinical characteristics are provided in Table 1. Patients’ primary languages were English (36%, 164/460), Spanish (27%, 122/460) and Portuguese (25%, 114/460). Among the 64 patients who were hospitalized, the outpatient clinic evaluation occurred an average of 2.85 days (± 3.77, range 0–18) prior to hospitalization. In multivariable analyses, older age (50–64 years compared to 18–49 years, adjusted OR (aOR) 3.73 [95% CI 1.94, 7.16]; ≥ 65 years compared to 18–49 years, aOR 10.99 [4.95, 24.41]), Spanish as primary language (compared to English, aOR 2.99 [1.39, 6.39]),

| Characteristic | n (%) |
|----------------|-------|
| **Demographic characteristics** | |
| Age categories | |
| 18–49 | 282 (61.3) |
| 50–64 | 136 (29.6) |
| 65 + | 42 (9.1) |
| Sex | |
| Female | 292 (63.5) |
| Male | 168 (36.5) |
| Primary language | |
| English | 164 (35.7) |
| Portuguese | 114 (24.8) |
| Spanish | 122 (26.5) |
| Other | 60 (13.0) |
| **Health characteristics** | |
| BMI status | |
| Obese (BMI of 30 kg/m² or greater) | 233 (50.7) |
| Overweight (BMI of 25–29.9 kg/m²) | 149 (32.4) |
| Normal weight (BMI of 18.5 to 24.9 kg/m²) | 75 (16.3) |
| Underweight (BMI below 18.5 kg/m²) | 3 (0.7) |
| Hypertension | 125 (27.2) |
| Chronic lung disease | 95 (20.7) |
| Coronary artery disease | 23 (5.0) |
| Diabetes | 77 (16.7) |
| Chronic kidney disease | 14 (3.0) |
| Immunocompromised | 21 (4.6) |
| Chronic liver disease | 25 (5.4) |
| Tobacco use (current or former smoker status) | 89 (19.4) |
| **Self-reported symptom history** | |
| Fever, chills, or night sweats | 304 (66.1) |
| Cough | 350 (76.1) |
| Chest pain, discomfort or tightness | 121 (26.3) |
| Dyspnea | 274 (59.6) |
| GI symptoms (nausea, vomiting, diarrhea, abdominal pain) | 172 (37.4) |
| Headache | 150 (32.6) |
| Dizziness or lightheadedness | 46 (10.0) |
| Loss of smell or taste (subjective) | 186 (40.4) |
| Myalgias, back pain or joint pain | 253 (55.0) |
| URI symptoms (rhinorrhea, sinus discomfort, nasal congestion, sore throat) | 158 (34.4) |
| **Vital signs taken at ambulatory clinic visit** | |
| Temperature of 99.5 degrees Fahrenheit or greater | 44 (9.8) |
| Heart rate of 100 bpm or greater | 219 (48.6) |
| Oxygen saturation | |
| 95% or above | 400 (87.7) |
| 91–94% | 42 (9.2) |
| 90% or lower | 14 (3.1) |
and higher BMI (BMI 25–29.9: 5.90 [1.31, 26.65]; BMI ≥ 30: aOR 7.32 [1.68, 31.97]) were associated with increased odds of hospitalization (Table 2). Multivariable analyses also showed that during the clinic visit, temperature ≥ 99.5° F (aOR 4.71 [2.22, 10.01]), tachycardia (aOR 2.20 [1.19, 4.05]), and oxygen saturation < 95% (aOR 11.87 [5.88, 23.96]) were associated with increased odds of hospitalization (Table 2). In self-reported symptom histories, report of dizziness/light-headedness (aOR 2.70 [1.20, 6.09]) was also associated with increased odds of hospitalization (Table 2). Although men had a slightly higher prevalence of hospitalization, sex was not associated with increased odds of hospitalization. Of note, several comorbidities including hypertension, chronic kidney disease, and diabetes were associated with increased odds of hospitalization but these associations were attenuated after adjustment for age, sex, and BMI of 25 or above.

Discussion

We found that several clinical factors along with Spanish as primary language increased the odds of hospitalization among patients diagnosed with COVID-19 in our urban, ambulatory setting. As was the case in our cohort, increased age has consistently been found to be associated with worse prognosis in COVID-19 [7]. Prior evidence suggests that obesity, fever, tachycardia and hypoxia are more common among critically ill patients, aligning with our findings in our ambulatory setting [7, 8]. Our study also supports preliminary evidence from hospital settings that being overweight (BMI of 25–29.9 kg/m²) and experiencing dizziness may also be associated with severe disease [9, 10].

Research in Massachusetts has begun to explore the disproportionate impact of COVID-19 among Hispanic and Black communities, highlighting profound health inequities [2–4]. Our analysis identifies this disparity along another axis—primary language spoken. This finding is in line with a study of another large safety net hospital system in Boston that found that among 2729 patients with SARS-CoV-2 in Massachusetts’ first wave, a higher proportion of Hispanic patients were hospitalized than were Black or non-Hispanic white [2].

In Massachusetts, 24% of residents speak a language other than English at home, with Spanish being the most common non-English language (approximately 9% of overall residents) followed by Portuguese (approximately 3% of overall residents) [11]. In our clinic, all patients had access to a clinician fluent in their language or professional interpreter services. Our findings raise concerns regarding the utility of using the category “Hispanic” to identify patient populations that may be at higher risk of hospitalization due to COVID-19. The majority of Spanish-speaking patients in our cohort were born in Central America whereas the majority of our Portuguese-speaking patients were born in Brazil. In our patient population, some, but not all, Portuguese-speaking patients may identify as Hispanic. As such, language may be a useful marker to help investigate external factors and systemic inequities that contribute to increased disease risk among Massachusetts residents.

A more nuanced and clinically relevant understanding of risk for severe COVID-19 will require moving beyond our current use of general category terms such as “Hispanic” to explicitly assess specific social determinants of health in care of individual patients. Economic segregation, housing, and barriers to healthcare access among other social determinants of health likely contribute to the disparity between primary Spanish-, Portuguese- and English-speaking patients and require further study. Of note, our study data were collected during the first wave of the coronavirus pandemic in Massachusetts, during which a stay-at-home advisory was in effect beginning on March 23, 2020. While most employees were required to remain at home, essential employees including those working in healthcare, food and agriculture were excluded from the stay-at-home order. The differences we found in hospitalization between Spanish-, Portuguese- and English-speaking persons may have been impacted, in part, by differences in occupational risk of infection associated with these initial orders.

Our study had several limitations. It had a relatively small sample size and involved a single, safety net institution. Findings were also ultimately limited to patients who accessed care at the clinic, limiting generalizability. Several clinical variables including respiratory rate, blood
Table 2  Odds ratios of future hospitalization by demographic and clinical characteristics of patients infected with SARS-CoV-2 (n=460)

| Characteristic                      | n    | Hospitalized n (%) | Unadjusted OR (95% CI)a | Adjusted OR (95% CI)b |
|-------------------------------------|------|--------------------|-------------------------|-----------------------|
| **Demographic characteristics**    |      |                    |                         |                       |
| Age categories                      |      |                    |                         |                       |
| 18–49                               | 282  | 17 (6.0)           | Ref                     | Ref                   |
| 50–64                               | 136  | 27 (19.9)          | 3.86 (2.02, 7.37)*      | 3.73 (1.94, 7.16)*    |
| 65 +                                | 42   | 18 (42.9)          | 11.69 (5.34, 25.59)*    | 10.99 (4.95, 24.41)*  |
| Sex                                 |      |                    |                         |                       |
| Female                              | 292  | 34 (11.6)          | Ref                     | Ref                   |
| Male                                | 168  | 28 (16.7)          | 1.52 (0.88, 2.61)       | 1.46 (0.81, 2.60)     |
| Primary language                    |      |                    |                         |                       |
| English                             | 164  | 13 (7.9)           | Ref                     | Ref                   |
| Portuguese                          | 114  | 14 (12.3)          | 1.63 (0.73, 3.61)       | 1.83 (0.78, 4.28)     |
| Spanish                             | 122  | 27 (22.1)          | 3.30 (1.62, 6.71)*      | 2.99 (1.39, 6.39)*    |
| Other                               | 60   | 8 (13.3)           | 1.79 (0.70, 4.55)       | 1.31 (0.48, 3.62)     |
| **Health characteristics**          |      |                    |                         |                       |
| BMI status                           |      |                    |                         |                       |
| Obese (BMI of 30 kg/m² or greater)  | 233  | 39 (16.7)          | 7.64 (1.80, 32.40)*     | 7.32 (1.68, 31.97)*   |
| Overweight (BMI of 25–29.9 kg/m²)   | 149  | 21 (14.1)          | 6.23 (1.42, 27.31)*     | 5.90 (1.31, 26.65)*   |
| Normal and underweight (BMI of 24.9 kg/m² or less)c | 78  | 2 (2.6)           | Ref                     | Ref                   |
| Hypertension                        |      |                    |                         |                       |
| Yes                                 | 125  | 26 (20.8)          | 2.18 (1.25, 3.79)*      | 0.98 (0.52, 1.88)     |
| No                                  | 335  | 36 (10.8)          | Ref                     | Ref                   |
| Chronic lung disease                |      |                    |                         |                       |
| Yes                                 | 95   | 10 (10.5)          | 0.71 (0.35, 1.45)       | 0.70 (0.33, 1.51)     |
| No                                  | 365  | 52 (14.3)          | Ref                     | Ref                   |
| Coronary artery disease             |      |                    |                         |                       |
| Yes                                 | 23   | 8 (34.8)           | 3.78 (1.53, 9.34)*      | 1.37 (0.48, 3.89)     |
| No                                  | 437  | 54 (12.4)          | Ref                     | Ref                   |
| Diabetes                            |      |                    |                         |                       |
| Yes                                 | 77   | 20 (26.0)          | 2.85 (1.56, 5.20)*      | 1.39 (0.70, 2.76)     |
| No                                  | 383  | 42 (11.0)          | Ref                     | Ref                   |
| Chronic kidney disease              |      |                    |                         |                       |
| Yes                                 | 14   | 7 (50.0)           | 7.11 (2.40, 21.04)*     | 2.49 (0.70, 8.91)     |
| No                                  | 446  | 55 (12.3)          | Ref                     | Ref                   |
| Immunocompromisedd                  |      |                    |                         |                       |
| Yes                                 | 21   | 3 (14.3)           | 1.07 (0.31, 3.76)       | 0.92 (0.24, 3.47)     |
| No                                  | 439  | 59 (13.4)          | Ref                     | Ref                   |
| Chronic liver disease               |      |                    |                         |                       |
| Yes                                 | 25   | 6 (24.0)           | 2.14 (0.82, 5.58)       | 1.76 (0.63, 4.91)     |
| No                                  | 435  | 56 (12.9)          | Ref                     | Ref                   |
| Tobacco use (current or former smoker status) |      |                    |                         |                       |
| Yes                                 | 89   | 13 (14.6)          | 1.12 (0.58, 2.18)       | 0.71 (0.34, 1.47)     |
| No                                  | 371  | 49 (13.2)          | Ref                     | Ref                   |
| Self-reported symptom history       |      |                    |                         |                       |
| Fever, chills or night sweats       |      |                    |                         |                       |
| Yes                                 | 304  | 47 (15.5)          | 1.72 (0.93, 3.18)       | 1.83 (0.94, 3.57)     |
| No                                  | 156  | 15 (9.6)           | Ref                     | Ref                   |
| Cough                               |      |                    |                         |                       |
| Yes                                 | 350  | 48 (13.7)          | 1.09 (0.58, 2.06)       | 1.10 (0.55, 2.18)     |
| No                                  | 110  | 14 (12.7)          | Ref                     | Ref                   |
pressure, and serologic tests were not consistently collected at our clinic. We were also unable to evaluate which social determinants of health or other factors may underlie the increased risk of hospitalization. Additional socioeconomic variables such as income, employment status, household size, and education were not consistently available in the

| Table 2 (continued) |
|----------------------|
| Characteristic       | n    | Hospitalized n (%) | Unadjusted OR (95% CI)\(^a\) | Adjusted OR (95% CI)\(^b\) |
|----------------------|------|--------------------|-----------------------------|-----------------------------|
| Chest pain, discomfort, tightness or pleuritic chest pain | Yes  | 121 | 8 (6.6) | 0.37 (0.17, 0.81)* | 0.48 (0.21, 1.08) |
|                      | No   | 339 | 54 (15.9) | Ref | Ref |
| Dyspnea              | Yes  | 274 | 39 (14.2) | 1.18 (0.68, 2.04) | 1.48 (0.80, 2.71) |
|                      | No   | 186 | 23 (12.4) | Ref | Ref |
| GI symptoms (nausea, vomiting, diarrhea, abdominal pain) | Yes  | 172 | 23 (13.4) | 0.99 (0.57, 1.72) | 1.09 (0.60, 1.98) |
|                      | No   | 288 | 39 (13.5) | Ref | Ref |
| Headache             | Yes  | 150 | 20 (13.3) | 0.98 (0.55, 1.74) | 1.48 (0.79, 2.78) |
|                      | No   | 310 | 42 (13.6) | Ref | Ref |
| Dizziness or lightheadedness | Yes  | 46  | 11 (23.9) | 2.24 (1.07, 4.68)* | 2.70 (1.20, 6.09)* |
|                      | No   | 414 | 51 (12.3) | Ref | Ref |
| Loss of smell or taste (subjective) | Yes  | 186 | 16 (8.6) | 0.47 (0.26, 0.85)* | 0.68 (0.36, 1.31) |
|                      | No   | 274 | 46 (16.8) | Ref | Ref |
| Myalgias, back pain or joint pain | Yes  | 253 | 29 (11.5) | 0.68 (0.40, 1.17) | 0.69 (0.38, 1.22) |
|                      | No   | 207 | 33 (15.9) | Ref | Ref |
| URI symptoms (rhinorrhea, sinus discomfort, nasal congestion, sore throat) | Yes  | 158 | 16 (10.1) | 0.63 (0.34, 1.15) | 0.85 (0.44, 1.64) |
|                      | No   | 302 | 46 (15.2) | Ref | Ref |
| **Vital signs taken at ambulatory clinic visit** |                   |                   |                   |                   |
| Temperature of 99.5 degrees Fahrenheit or greater\(^c\) | Yes  | 44  | 17 (38.6) | 5.43 (2.73, 10.77)* | 4.71 (2.22, 10.01)* |
|                      | No   | 404 | 42 (10.4) | Ref | Ref |
| Tachycardia (Heart rate of 100 bpm or greater)\(^d\) | Yes  | 219 | 38 (17.4) | 2.11 (1.19, 3.73)* | 2.20 (1.19, 4.05)* |
|                      | No   | 232 | 21 (9.1) | Ref | Ref |
| Oxygen saturation below 95%\(^e\) | Yes  | 56  | 32 (57.1) | 16.44 (8.61, 31.40)* | 11.87 (5.88, 23.96)* |
|                      | No   | 400 | 30 (7.5) | Ref | Ref |

SARS-CoV-2 severe acute respiratory syndrome coronavirus 2, OR odds ratio, CI confidence interval, ref referent category, BMI body mass index, kg kilograms, m meters, GI gastrointestinal, URI upper respiratory infection, bpm beats per minute

\(^a\) p value < 0.05

\(^b\) Separate logistic regression models were run for each risk factor, associations between the risk factor and odds of hospitalization are presented along with 95% confidence intervals

\(^c\) Logistic regression models were adjusted for age category, sex, and BMI of 25 or above (combined overweight and obesity categories)

\(^d\) Those without a documented BMI measure were designated as normal weight (n = 13)

\(^e\) Patients were considered immunocompromised if they were currently taking an immunosuppressive medication or had: functional or anatomic asplenia, previous diagnosis of HIV, previous diagnosis of autoimmune rheumatologic disease, or a diagnosis of cancer since January 2019

\(^f\) Among those with temperature taken at respiratory clinic visit, n = 448

\(^g\) Among those with heart rate taken at respiratory clinic visit, n = 451

\(^h\) Among those with oxygen saturation measured at respiratory clinic, n = 456
Conclusion

Our study provides additional information on the markers of severe disease risk among a diverse cohort of patients at a community clinic in Massachusetts during the initial surge of COVID-19. Notably, we found that speaking Spanish, but not Portuguese, as primary language was associated with increased odds of hospitalization after adjustment for age, sex, and BMI. Our results may help guide future research into the social determinants underlying COVID-19’s disparate impact on communities in Massachusetts, inform policy identifying and addressing root causes of health inequities in Massachusetts, and help clinicians with more nuanced understanding of risk for hospitalization among outpatients with COVID-19.

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Authors contribution  Study conceptualization: PC, YS; Development or design of methodology: PC, DN, YS, HS; Statistical analysis: LR; Data investigation: PK, CL, DN, HS; Writing - first draft preparation: PC; Writing - review and editing: PC, CL, DN, PK, LR, HS, YS; Supervision: PC, YS.

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Declarations

Conflict of interest  Financial interests: Dr. Cohen reports receiving compensation from UptoDate. Non-financial interests: None.

Ethical Approval  This quality improvement study met criteria for determination of non-human subject research by the Cambridge Health Alliance institutional review board.

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