COVID-19 IN MINNESOTA

Epidemiology of hospitalized patients April through June 2020

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Severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) was first identified in December 2019 in China. Subsequently, millions of coronavirus disease 2019 (COVID-19) cases have been identified worldwide. The Minnesota Department of Health (MDH) implemented statewide surveillance for laboratory-confirmed, hospitalized COVID-19 cases as a part of the Centers for Disease Control and Prevention Emerging Infections Program Network. A total of 3,817 laboratory-confirmed cases of COVID-19 were hospitalized between April 1 and June 30, 2020. Ten percent of COVID-19 cases in Minnesota were hospitalized, with an incidence of 63 hospitalized cases per 100,000 population. Among 3,751 cases (94%) with medical record review, median age was 59 years, 78% had >1 comorbidity, 63% had >2 comorbidities, 30% required admission to an intensive care unit, and 13% died. Racial and ethnic minorities were over-represented and more than 80% of cases were from the Minneapolis-St. Paul metropolitan area. COVID-19 hospitalizations in Minnesota were similar to reports from other parts of the United States in spring 2020, with disparate populations affected and high rates of ICU admission and in-hospital death.

Introduction

Severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) was initially identified in Wuhan, China, in December 2019. From the initial identification through August 1, 2020, 17 million cases of COVID-19 and 675,000 deaths were reported globally[1]; the United States was the largest contributor, with more than 4.5 million cases and 152,000 deaths.

The first laboratory-confirmed case of COVID-19 in a Minnesota resident was identified on March 6, 2020. The patient was male, in his 70s, and had recently returned from a cruise. Initial cases in Minnesota were associated with international travel; however, testing at the time was restricted to certain international travelers as per the U.S. Centers for Disease Control

FIGURE 1

Case Counts and Rate of Hospitalized COVID-19 Cases by Week of Admission and Region, April 1 - June 30, 2020
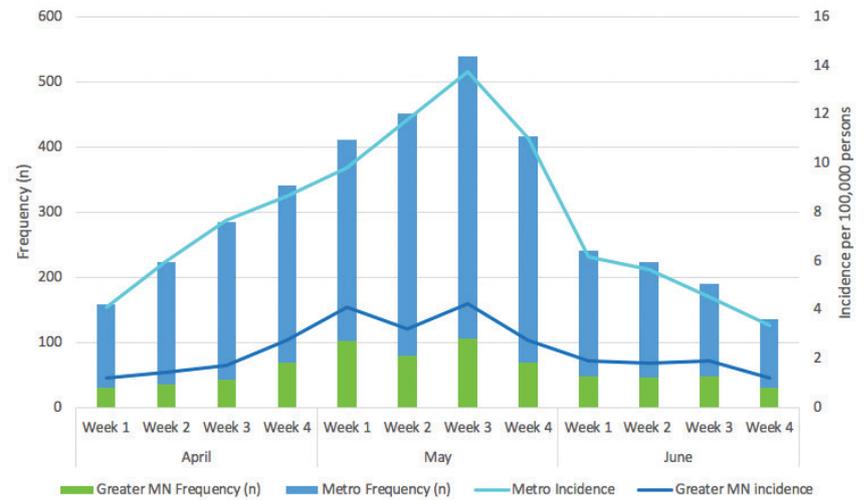

FIGURE 2

Non-Hospitalized COVID-19 Cases by Week of Specimen Collection and Region, April 1 – June 30, 2020
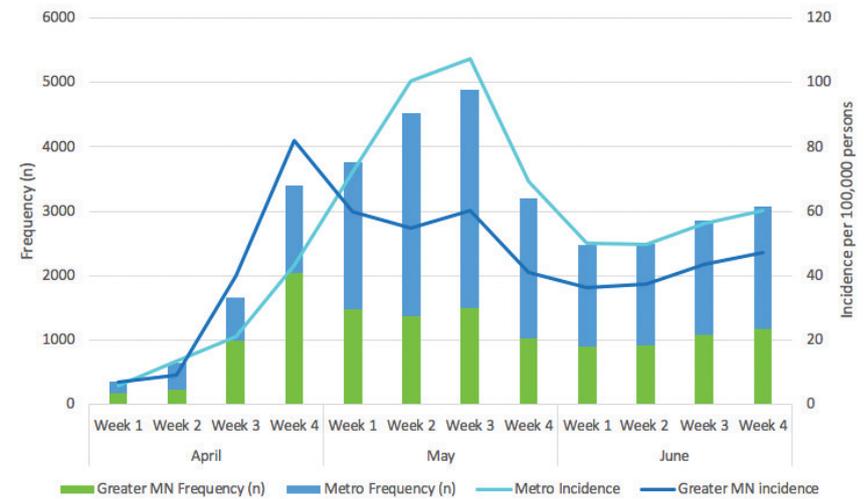
TABLE 1

Demographic and clinical characteristics of cases hospitalized with COVID-19, April 1–June 30, 2020

	METROPOLITAN AREA* N (%)	GREATER MINNESOTA N (%)	P-VALUE	TOTAL N (%)
TOTAL	n = 2,877	n = 694		n = 3,571
Age in years (median, IQR)	60, 45 – 74	57, 42 - 69	<0.001	59, 44 - 73
AGE CATEGORY: <18 years	54 (2)	19 (3)	NS	73 (2)
AGE CATEGORY: 18 - 49 years	812 (28)	216 (31)	NS	1,028 (29)
AGE CATEGORY: 50 - 64 years	815 (28)	236 (34)	<0.001	1,051 (29)
AGE CATEGORY: 65 - 75 years	678 (24)	142 (20)	NS	820 (23)
AGE CATEGORY: ≥75 years	518 (18)	81 (12)	<0.001	599 (17)
Male	1,398 (49)	373 (54)	0.011	1,771 (50)
RACE/ETHNICITY: Non-Hispanic White	1,221 (42)	308 (44)	NS	1,529 (43)
RACE/ETHNICITY: Non-Hispanic Black	786 (27)	115 (17)	<0.001	901 (25)
RACE/ETHNICITY: Asian/Pacific Islander	350 (12)	46 (7)	<0.001	396 (11)
RACE/ETHNICITY: American Indian/Alaskan Native	64 (2)	19 (3)	NS	83 (2)
RACE/ETHNICITY: Hispanic Ethnicity	403 (14)	160 (23)	<0.001	563 (16)
RESIDENCE AT ADMISSION: Private residence	1,933 (67)	568 (82)	<0.001	2,501 (70)
RESIDENCE AT ADMISSION: Facility**	869 (30)	109 (16)	<0.001	978 (27)
RESIDENCE AT ADMISSION: Homeless/Shelter	54 (2)	7 (1)	NS	61 (2)
RESIDENCE AT ADMISSION: Home with services	17 (1)	4 (1)	NS	21 (1)
RESIDENCE AT ADMISSION: Corrections	1 (<1)	5 (1)	NS	6 (<1)
RESIDENCE AT ADMISSION: Hospice	2 (<1)	0 (0)	NS	2 (<1)
Pregnant at admission (n = 567)	166 (6)	36 (5)	NS	202 (6)
Current/former smoker	986 (34)	242 (35)	NS	1,228 (34)
No smoking history	1,891 (66)	452 (65)	NS	2,343 (66)
UNDERLYING CHRONIC CONDITION (N=2,779)**:** Presence of ≥ 1 underlying condition	2,252 (78)	527 (76)	NS	2,779 (78)
UNDERLYING CHRONIC CONDITION: Hypertension	1,498 (52)	315 (45)	<0.001	1,813 (51)
UNDERLYING CHRONIC CONDITION: Obesity	981 (34)	273 (39)	0.011	1,254 (35)
UNDERLYING CHRONIC CONDITION: Chronic lung disease	756 (26)	190 (27)	NS	946 (26)
Asthma	330 (11)	69 (10)	NS	399 (11)
COPD/Emphysema	255 (9)	54 (8)	NS	309 (9)
Obstructive sleep apnea	300 (10)	90 (13)	NS	390 (11)
UNDERLYING CHRONIC CONDITION: Metabolic diseases	1,124 (39)	275 (40)	NS	1,399 (39)
Diabetes	926 (32)	224 (32)	NS	1,150 (32)
Thyroid dysfunction	281 (10)	57 (8)	NS	338 (9)
UNDERLYING CHRONIC CONDITION: Cardiovascular disease	908 (32)	196 (28)	NS	1,104 (31)
Atrial fibrillation	266 (9)	53 (8)	NS	319 (9)
History of stroke/CVA	242 (8)	36 (5)	0.005	278 (8)
Coronary artery disease	274 (10)	70 (10)	NS	344 (10)
Congestive heart failure/Heart failure	274 (10)	55 (8)	NS	329 (9)
UNDERLYING CHRONIC CONDITION: Neurologic conditions	772 (27)	122 (18)	<0.001	894 (25)
Dementia	386 (13)	32 (5)	<0.001	418 (12)

and Prevention (CDC) criteria. As testing became more widely available in Minnesota and testing criteria broadened, cases associated with community transmission and outbreaks in congregate and other settings were detected. Minnesota COVID-19 cases increased to over 55,000 cases and 1,600 deaths through August 1, 2020.[2] Disease severity has been associated with comorbidities and certain demographic characteristics.[3-5] We reviewed data on hospitalized cases of COVID-19 in Minnesota to describe the characteristics and outcomes of these cases, including critical and fatal illnesses.

Methods

The Minnesota Department of Health (MDH) conducts surveillance for patients hospitalized with SARS-CoV-2 as part of the CDC Emerging Infections Program (CDC EIP) COVID-19-Associated Hospitalization Surveillance Network (COVID-NET). COVID-NET methods have been defined elsewhere.[3] Briefly, cases are defined as patients admitted to a hospital with SARS-CoV-2 infection, confirmed by laboratory testing, within 14 days prior to or during hospitalization. Laboratory testing was ordered at the discretion of the health care provider. COVID-NET includes residents of all ages, of the seven-county Minneapolis-St. Paul metropolitan area (Anoka, Carver, Dakota, Hennepin, Ramsey, Scott, and Washington Counties). However, MDH expanded surveillance to

NS = not significant

IQR=Interquartile range

* Metropolitan area includes residents of Anoka, Carver, Dakota, Hennepin, Ramsey, Scott and Washington Counties

** Facility includes nursing/skilled nursing, assisted living, group home, rehabilitation, alcohol/drug facilities, and psychiatric care

*** Obesity defined as body mass index ≥ 30

**** The following underlying conditions were reported among ≤ 5% of cases: blood disorders, gastrointestinal/liver disease, neuropathy, rheumatologic/autoimmune conditions, and seizure disorders/epilepsy.

include Minnesota residents throughout the state using COVID-NET methods.

Medical record reviews were conducted by trained surveillance officers using a standardized case report form and protocol. Data collected included demographic (age, sex, race, and ethnicity) and clinical variables (symptoms at time of admission, presence of underlying medical conditions, admission to an intensive care unit [ICU], laboratory testing, treatment, imaging, and discharge diagnoses and disposition).

Cases with an admission date from April 1 through June 30, 2020 were included in this analysis. Analysis included a descriptive review of demographics, underlying conditions, and outcome (e.g., ICU admission, in-patient mortality). Multivariate models included age groups (<18 years, 18–49 years, 50–64 years, 65–74 years, ≥75 years), sex, race, and ethnicity. Variables were included in multivariate analysis when the p-value was < 0.05. Multivariate analysis was conducted using PROC LOGISTIC and PROC GEN-MOD controlling for age and presence of an underlying condition. Case data were analyzed using SAS version 9.4 software (SAS Institute Inc., Cary, NC, USA).

Data were collected as part of routine public health surveillance and not subject to Institutional Review Board approval.

Results

A total of 37,192 laboratory-confirmed cases were identified with a specimen collection date from April 1 through June 30, 2020. Overall, case incidence for laboratory-confirmed cases was 677 per 100,000 persons. Ninety percent (33,375) of cases were not hospitalized. A total of 3,817 hospitalized COVID-19 patients were identified with an admission date from April 1 through June 30, 2020. After excluding 246 patients where chart abstractions had not yet been completed, 3,571 (94%) were included in this analysis (97% chart review completion for seven-county metropolitan area residents, and 83% completion for charts of greater Minnesota residents). Two thousand eight hundred seventy-seven (81%) cases resided in the metropolitan area, and 694 (19%) were greater Minnesota residents. Overall incidence for hospitalizations was 63 cases per 100,000 persons. Admissions peaked in the middle of May and had a steady downward trend into June for both residents of the metropolitan area and greater Minnesota (Figure 1), while non-hospitalized cases saw a steady increase throughout June (Figure 2).

Among 3,571 cases, the median age was 59 years (IQR (interquartile range): 44–73 years) with 69% >50 years (Table 1). The median age for hospitalized cases was significantly older than the median age of 38 years (IQR 25-55 years) for overall cases (p<0.001). Statewide, males (1,771) and females (1,800) were equally represented among cases. However, the proportion of males significantly differed among those living in greater Minnesota compared to those in the metropolitan area (49% vs 54%, p=0.011). Forty-three percent (1,529) of cases were non-Hispanic white, 25% (901) were non-Hispanic Black, 11% (396) were Asian/Pacific Islander, and 2% (83) were American Indian/Alaskan Native. The proportion of cases that were non-Hispanic Black and Asian/Pacific Islanders was greater among cases from the metropolitan area compared to greater Minnesota (27% vs 17%, p<0.001 and 12% vs 7%, p<0.001 respectively). Sixteen percent of all cases (563) were Hispanic, and the proportion of cases that were Hispanic was higher among greater Minnesota residents than among the metropolitan residents (23% vs 14%, p<0.001). Most patients resided in a private residence prior to admission (70%) with 27% residing at a facility (including nursing/skilled nursing, assisted living, group home, rehabilitation, alcohol/drug facilities, and psychiatric care). The

TABLE 2

Clinical characteristics of cases hospitalized with COVID-19, April 1–June 30, 2020

	METROPOLITAN AREA* N (%)	GREATER MINNESOTA N (%)	P-VALUE	TOTAL
TOTAL	n = 2,877	n = 694		N = 3571
Days length of stay, median (IQR)				5 (3-11)
Days from symptom onset to admission, median (IQR)				6 (3-9)
Days of ICU stay, median (IQR)				29 (18-44)
ANY SYMPTOMS AT ADMISSION	2,528 (88)	647 (93)	<0.001	3,175 (89)
Cough	1,552 (54)	442 (64)	<0.001	1,994 (56)
Shortness of breath/Respiratory distress	1,553 (54)	458 (66)	<0.001	2,011 (56)
Fever	1,549 (54)	444 (64)	<0.001	1,993 (56)
Diarrhea	502 (17)	160 (23)	<0.001	662 (19)
Nausea/vomiting	522 (18)	157 (23)	<0.001	679 (19)
Myalgia	536 (19)	204 (29)	<0.001	740 (21)
No symptoms at admission	349 (12)	47 (7)	<0.001	396 (11)
High-flow nasal cannula	604 (21)	181 (26)	0.004	785 (22)
BiPAP/CPAP	441 (15)	108 (16)	NS	549 (15)
Mechanical ventilation	508 (18)	121 (17)	NS	629 (18)
ECMO	20 (1)	3 (<1)	NS	23 (1)
ICU admission	856 (30)	222 (32)	NS	1,078 (30)
Died during hospitalization	384 (13)	70 (10)	0.023	454 (13)

NS = not significant

IQR=Interquartile range

* Metropolitan area includes residents of Anoka, Carver, Dakota, Hennepin, Ramsey, Scott and Washington Counties

proportion of cases admitted from a facility was greater among metropolitan cases compared to greater Minnesota cases (30% vs 16%, p<0.001). Only 6% (153) of cases worked in a health care setting and this did not differ by the residence of the case. Of cases identified among 567 females of child-bearing age (15–49 years), 202 (6%) were pregnant at hospital admission (Table 1).

Seventy-eight percent (2,779) of all cases had at least one underlying medical condition at the time of admission with 2,244 of those patients having two or more underlying conditions. Hypertension

(51%), obesity defined as having a body mass index (BMI) ≥ 30 (35%), and diabetes mellitus (32%) were the most commonly recorded underlying conditions. Specific underlying conditions differed by residence in the metropolitan area compared to greater Minnesota (Table 1).

The median length of hospital stay was 5 days (IQR: 3–11 days), and the median length of time between symptom onset for those with respiratory symptoms and admission was 6 days (IQR: 3–9 days). Cough (56%), shortness of breath/respiratory distress (56%), and fever (56%) were the most frequently documented symp-

toms at admission. Eleven percent (396) of cases had no documented symptoms at admission, 202 of which were pregnant women tested at delivery.

Fifty-five percent (1,963) of patients required respiratory support, with 22% requiring high-flow nasal cannula (HFNC), 15% requiring bi-level positive airway pressure (BiPAP) or continuous positive airway pressure (CPAP), and 18% requiring mechanical ventilation. Twenty-three patients required extracorporeal membrane oxygenation (ECMO) (Table 2). Patients that required respiratory support of any form had a higher median age than

TABLE 3

Risk Factors for ICU Admission and In-hospital Death among Hospitalized COVID-19 cases, April 1–June 30, 2020

	ICU ADMISSION			IN-HOSPITAL DEATH		
	ICU ADMISSION N (%)	NO ICU ADMISSION N (%)	OR (CI)	DIED N (%)	SURVIVED N (%)	OR (CI)
TOTAL	1,078	2,493		454	3,116	
Female	446 (41)	1,354 (54)	REF	195 (43)	1,605 (52)	REF
Male	632 (59)	1,138 (46)	1.66 (1.44, 1.93)	259 (57)	1,511 (48)	1.69 (1.36, 2.09)
AGE CATEGORY: <18 years	18 (2)	55 (2)	--	0	73 (2)	--
AGE CATEGORY: 18-49 years	254 (24)	773 (31)	REF	18 (4)	1,009 (32)	REF
AGE CATEGORY: 50-64 years	375 (35)	676 (27)	1.59 (1.28, 1.90)	101 (22)	950 (30)	5.03 (3.00, 8.45)
AGE CATEGORY: 65-75 years	297 (28)	523 (21)	1.55 (1.24, 1.92)	172 (38)	648 (21)	11.82 (7.08, 19.73)
AGE CATEGORY: >75 years	134 (12)	465 (19)	NS	163 (36)	436 (14)	16.46 (9.81, 27.63)
RACE/ETHNICITY: Non-Hispanic White	404 (37)	1125 (45)	REF	257 (57)	1,254 (40)	REF
RACE/ETHNICITY: Non-Hispanic Black	263 (24)	638 (26)	NS	83 (18)	813 (26)	NS
RACE/ETHNICITY: Asian/Pacific Islander	170 (16)	226 (9)	2.17 (1.73, 2.73)	49 (11)	342 (11)	NS
RACE/ETHNICITY: American Indian/Alaskan Native	28 (3)	55 (2)	NS	19 (4)	63 (2)	3.578 (2.062, 6.289)
RACE/ETHNICITY: Hispanic Ethnicity	181 (17)	381 (15)	1.247 (1.01, 1.53)	32 (7)	530 (17)	NS
No underlying conditions	197 (18)	595 (24)	REF	26 (6)	766 (25)	REF
One underlying condition	173 (16)	361 (14)	1.479 (1.155, 1.894)	41 (9)	493 (16)	NS
Two or more underlying conditions	708 (66)	1536 (62)	1.434 (1.159, 1.774)	387 (85)	1857 (60)	2.257 (1.452, 3.510)
UNDERLYING CHRONIC CONDITION: Chronic lung	319 (30)	627 (25)	NS	153 (34)	793 (25)	NS
UNDERLYING CHRONIC CONDITION: Diabetes	434 (40)	716 (29)	1.682 (1.443, 1.959)	208 (46)	942 (30)	1.784 (1.445, 2.201)
UNDERLYING CHRONIC CONDITION: Cardiovascular	350 (32)	754 (30)	NS	248 (55)	856 (27)	1.298 (1.026, 1.643)
UNDERLYING CHRONIC CONDITION: Neurologic	253 (23)	641 (26)	NS	187 (41)	707 (23)	NS
UNDERLYING CHRONIC CONDITION: Immmunocompromised	76 (7)	178 (7)	NS	45 (10)	209 (7)	NS
UNDERLYING CHRONIC CONDITION: Renal disease	216 (20)	369 (15)	1.452 (1.183, 1.783)	156 (34)	429 (14)	1.679 (1.322, 2.133)
UNDERLYING CHRONIC CONDITION: Gastrointestinal/Liver	73 (7)	113 (5)	1.406 (1.031, 1.916)	36 (8)	150 (5)	1.566 (1.050, 2.335)
UNDERLYING CHRONIC CONDITION: Obesity	443 (41)	811 (33)	1.319 (1.115, 1.562)	166 (37)	1088 (35)	NS
UNDERLYING CHRONIC CONDITION: Hypertension	582 (54)	1,231 (49)	NS	309 (68)	1504 (48)	NS

ICU=Intensive care unit; OR = odd ratio, CI=confidence interval, REF= reference for comparison, NS= not significant

those that did not need respiratory support (median age: 62 years, IQR: 51–73 years vs median age: 59 years, IQR: 43–75 years, respectively; p < 0.001).

Overall, 30% (1,078) of cases were admitted to the ICU. The median length of stay in the ICU was 29 days (IQR: 18–44 days). Length of stay in the ICU was associated with sex (p=0.004), race (p<0.001), and the number of underlying medical conditions present (p=0.002). When controlling for age and presence of an underlying condition, males were more likely to be admitted to the ICU (OR: 1.66, 95% CI: 1.44–1.93, p<0.001) compared to females. Patients aged 50–74 years were also more likely to be admitted to the ICU (p<0.001) compared to those aged 18–49 years. After controlling for sex and age, Asian/Pacific Islanders (OR: 2.17, 95% CI: 1.73–2.73, p=0.003) and Hispanics overall (OR: 1.25, 95% CI: 1.01, 1.53, p=0.034) were more likely to be admitted to the ICU when compared to non-Hispanic whites (Table 3). After controlling for age and sex, underlying conditions that were associated with ICU admission were diabetes (OR: 1.68, 95% CI: 1.44–1.96), renal disease (OR: 1.45, 95% CI: 1.18–1.78), gastrointestinal/liver disease (OR: 1.41, 95% CI: 1.03–1.92), and obesity (OR: 1.32, 95% CI: 1.12–1.56).

From April 1 through June 30, 454 COVID patients died while hospitalized (13%). The risk of dying in the hospital significantly increased as age increased (p<0.001). Being male compared to female was associated with in-hospital mortality (OR: 1.69, 95% CI: 1.36–2.09). Median age of those that died was 74 years (IQR: 64–83 years), and was higher than those that survived (median age: 57 years, IQR: 42–71 years, p < 0.001). Although a greater proportion of metropolitan area residents died during hospitalization compared to residents of greater Minnesota (13% vs 10%, p=0.016) these differences were no longer observed when controlling for age and sex. While Asian/Pacific Islanders and Hispanics were more likely to be admitted to the ICU compared to white cases, only American Indians/Alaskan Natives were at an increased risk of

in-hospital mortality after controlling for age and sex (OR: 3.58, 95% CI: 2.06–6.29, p<0.001) (Table 3). Underlying conditions that were associated with an increased risk of dying in the hospital included diabetes (OR: 1.78, 95% CI: 1.45–2.20, p<0.001), renal disease (OR: 1.68, 95% CI: 1.32–2.13, p<0.001), gastrointestinal/liver disease (OR: 1.57, 95% CI: 1.05–2.34) and cardiovascular disease (OR: 1.30, 95% CI: 1.03–1.64), after controlling for age and sex.

There were 73 pediatric (<18 years) cases, with a median age of 9 years (IQR: 2–15 years) compared to 11 years (IQR: 5–15 years) in non-hospitalized pediatric cases. The median length of stay was 3 days (IQR: 2–5 days), less than adult cases when controlling for underlying comorbidities (p < 0.001). One quarter of pediatric cases (18) were admitted to the ICU overall with eight needing respiratory support, and four requiring intubation. Twenty-two (30%) pediatric cases hospitalized had at least one underlying condition, significantly less than the proportion of adult cases with underlying conditions (p < 0.001). The most common comorbidities among pediatric hospitalizations were neurologic conditions (8), immunocompromised conditions (6), metabolic and blood disorders (3). The presence of an underlying condition among pediatric cases was not significantly associated with ICU admission, and there were no deaths among pediatric hospitalized cases.

Discussion

Over 80% of hospitalized cases lived in the Minneapolis-St. Paul metropolitan area, with a higher proportion of non-Hispanic Blacks, Asian/Pacific Islanders, and facility residents being admitted compared to cases among greater Minnesota residents. Males and Hispanics contributed to higher admissions in greater Minnesota. The greater proportion of Hispanic cases in greater Minnesota may be related to outbreaks in meat processing plants.

Approximately 70% of cases who were hospitalized were people over the age of 50 years. ICU admission was significantly associated with older age, up until age 75

years. However, those older than 75 years may have patient directives in place regarding critical care. In-hospital mortality risk steadily increased as age increased. Additional variables have been added since this time period to the medical record review, to collect patient directives.

Similar to other reports, [6-9] we found that older adults, male sex, and the presence of diabetes, renal disease, gastrointestinal/liver disease, and cardiovascular disease were significantly associated with a higher risk of ICU admission and in-hospital death in Minnesota. The proportion of hospitalized COVID-19 cases requiring intubation, ICU admission or in-patient death was greater for COVID-19 than for influenza (using the 2017–2018 influenza season and same CDC EIP methodology), highlighting the severity of COVID-19 (18% vs 10%, 30% vs 12%, 13% vs 3%; unpublished data). Future analyses are planned that include the prevalence of these conditions by geographic and racial and ethnic populations.

Children accounted for a much lower proportion of hospitalized cases, and a lower proportion of those hospitalized had an underlying condition compared with adults. Notably, underlying conditions were not a significant risk factor for ICU admission despite a high proportion that required intensive care.

We observed a peak of admissions in May with a weekly decline toward June. We also observed a peak of overall case counts in the third week of May with a sharp decline, but began to rise as June progressed.

Some patients may have been hospitalized for non-COVID-19 reasons we could not distinguish. In June, CDC expanded the case report form to include questions regarding reason for admission and chief complaint in order to distinguish patients admitted for treatment of COVID-19, versus patients tested for pre-surgical and infection control purposes.

Our analysis is limited by a number of factors. Testing practices changed over time as tests became available and knowledge about SARS-CoV-2 transmission evolved. Initially, asymptomatic transmis-

sion was not widely recognized and testing was targeted at patients with recognized COVID-19 symptoms. Retrospective ascertainment of this information is ongoing but not included in this analysis. Cases residing in the metropolitan area were more likely to have a medical record review completed than cases in greater Minnesota. Therefore, data presented may not represent characteristics of all hospitalized cases in greater Minnesota for this time period.

We observed certain characteristics that were associated with poorer outcome among patients hospitalized with COVID-19, including older age and presence of comorbidities. Specific racial and ethnic groups were also at higher risk for ICU admission and in-patient death even after controlling for sex and age. These finding highlight the need for preventive measures, especially to protect those populations most vulnerable to COVID-19. Ongoing surveillance of hospitalized COVID-19 cases is needed monitor trends in rates and case demographic, clinical and outcome characteristics. These data can help inform targeted education and prevention measures. MM

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