

Does Racial Disparity Exist Among Inpatient Admissions for Heart Attacks in Wisconsin?

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ABSTRACT

Objective: Acute myocardial infarction (AMI), or heart attack, carries a high inpatient death risk. Few national studies suggest race affects the outcomes of inpatients with AMI. In Wisconsin, an assessment of racial disparity among admissions for AMI is lacking.

Methods: Using the Wisconsin State Inpatient Database from 2016, demographics and outcomes for AMI admissions were analyzed. The goal was to compare demographic and hospitalization characteristics between non-Hispanic White patients and Black, Indigenous, and People of Color (BIPOC).

Results: A total of 6,002 non-Hispanic Whites and 546 BIPOC cases were identified. BIPOC were younger than non-Hispanic White inpatients (median age, 59 years vs 68 years, respectively; $P < 0.001$). Median length of stay was shorter in non-Hispanic White versus BIPOC (2 days vs 3 days; $P = 0.021$), and mean total charges were higher for BIPOC than non-Hispanic Whites (\$74,716 vs \$65,384, respectively; $P = 0.002$). Using a risk-adjusted model, inpatient mortality was increased for patients over 55 years of age (odds ratio [OR] 2.166; 95% CI, 1-3; $P = 0.001$) and women (OR 1.319; 95% CI, 1-1.6; $P = 0.03$). Race (BIPOC vs non-Hispanic White) was not predictive of inpatient death on univariable analysis (OR 0.771; 95% CI, 0.4-1.2; $P = 0.283$).

Conclusion: It appears BIPOC have longer hospital stays and incur higher charges than non-Hispanic White patients, though race does not affect mortality risk. Among Wisconsin counties with higher proportions of AMI, these data may enable strategic recommendation of hospitalized patients or permit risk stratification to identify disparity and encourage equitable care.

BACKGROUND

To provide equitable health care, it is necessary to first identify disparity. For certain health conditions, the identification of disparity may drastically improve patient outcomes. Acute myocardial

infarction (AMI), or heart attack, is a disease with a high risk of death. Despite evidence-based protocols for the treatment of AMI, few studies suggest early intervention and outcomes fare worse for Black, Indigenous, and People of Color (BIPOC) than non-Hispanic White (NHW) patients.¹⁻³ However, it is unclear whether racial disparity exists at a state level. In Wisconsin, a contemporary state-wide assessment of racial disparity in this setting is lacking.

According to the Healthcare Cost and Utilization Project (HCUP) State Inpatient Database (SID), Wisconsin inpatient systems recorded 602,279 admissions in 2016.⁴ AMI was among the most frequently admitted *International Code of Diseases, Tenth Edition* (ICD-10) codes, accounting for just over 1% of all hospitalizations. Given this volume, the SID is amenable to the study of a specific diagnosis to uncover racial disparity.

This investigation sought to: (1) assess the risk of inpatient mortality (or death) among NHW and BIPOC inpatients hospitalized in Wisconsin for AMI, and (2) to describe and compare patient demographics and hospitalization characteristics between NHW patients and BIPOC.

METHODS

Database

This retrospective study queried the Wisconsin HCUP SID for 2016. This database consists of inpatient admissions from 153 acute care, nonfederal community hospitals across Wisconsin.⁴ About 600,000 records of inpatient discharges are recorded from

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these hospitals annually, with up to another 28,000 coming from noncommunity hospitals, rehabilitation hospitals, and hospitals not included in the HCUP survey.⁵ Admissions for AMI were identified using ICD-10 code I21.⁶ Further divisions included I2101-2, I2109, I2111, I2119, I2121, I2129, I213, and I214.⁶ The inclusion criteria were cases that recorded race, and a total of 6,548 cases were identified. Minors (<18 years of age) and cases with missing race were excluded. Of the 6,548 cases, 91.7% (n=6,002) were NHW, 4.3% (n=284) were Black, 1.9% (n=125) were Hispanic, 1.2% (n=76) were Asian or Pacific Islander, and 0.9% (n=60) were Native American (1 unspecified or “other”). For analyses, this group was combined to include Black, Hispanic, Asian or Pacific Islander, Native American, and “other/unknown” race. While this is a heterogeneous group of non-White patients, this grouping system was used to make comparisons to national datasets, where similar classification systems have been described. Herein, this group is collectively referred to as BIPOC (Black, Indigenous, and People of Color)—a more person-centered term than “minority,” which has been used previously. Subgroup analyses were carried out between Black and NHW patients, and Hispanic and NHW patients. Given the small sample sizes of each individual BIPOC subgroup, however, these groups were combined to increase sample power. Of note, each group was not control-matched prior to statistical analyses.

Variables

Demographic variables such as age, sex, insurance payer, median household income (US dollars [USD]), and admitting ZIP code were recorded. Hospitalization variables included length of stay (days), total inpatient charges (USD), death, and disposition using UB-04 standard Centers for Medicare and Medicaid Services (CMS) coding.⁷ Total inpatient charges were cleaned data devoid of noncovered charges and professional fees. Each of the variables is described using the HCUP dictionary of variables.⁷

Statistical Analyses

Data were analyzed using descriptive statistics. Continuous variables of interest were represented as the mean or median with range, interquartile range (IQR), or standard deviation. Categorical variables were compared with chi-square or Fisher exact tests. A correlation matrix of race with potential confounding variables is provided (Appendix 1). Comparative analyses of parametric data were performed using a 2-tailed independent samples *t* test. A risk-adjusted binary regression model was used to predict inpatient death using odds ratios (OR). Only variables with significant univariate influence were included in the Tables and multivariate model. Statistical significance was set to $P < 0.05$, and all analyses were conducted on SPSS version 26.0 (IBM, Armonk, NY, USA).

Ethical Approval

To protect the privacy of physicians, hospitals, and patients, the entire dataset was deidentified using patient key identifiers.

According to the US Department of Health and Human Services, the use of administrative state inpatient databases under the HCUP does not require institutional review board approval as it is a publicly available, deidentified dataset.⁸

RESULTS

Demographics and Outcomes

Demographics and hospital outcomes of each group are summarized in Tables 1 and 2. For both the NHW and BIPOC groups, the most common admitting diagnosis within AMI (n=6,548) was non-ST elevation myocardial infarction (NSTEMI, ICD-10 code: I214), accounting for 65% of heart attacks (n=4,277). For all AMI, 6,002 (92%) cases occurred in NHW and 546 (8%) occurred in BIPOC. The median age at admission for NHW inpatients with AMI was 68 years (range, 21-104 years) compared to the BIPOC group (59 years, range 25-104; $P < 0.001$). For both the NHW and BIPOC group, the type of admission was most commonly an emergency as classified by the SID (54% and 75%, respectively), with the second most common admission type being urgent (42% and 23%, respectively; $P < 0.001$). The inpatient mortality rate was 3.5% in the BIPOC group and 4.5% in the NHW group ($P = 0.282$).

In the BIPOC group, the median length of inpatient stay was 3 days (range, 0-4 days) compared to NHW patients, who had a median hospital stay of 2 days (range, 0-94 days; $P = 0.021$). Similarly, the mean (SD) total inpatient charges in USD in the BIPOC group was \$74,716 (\$87,286) compared to the NHW group, which had a mean total charge of \$65,384 (\$64,665; $P = 0.002$). For the NHW group, the ZIP code with the highest rate of AMI was 54220 (Manitowoc County, n=74, 1.2%), while the ZIP code with the highest rate of AMI admissions for the BIPOC group was 53209 (Milwaukee County, n=225, 41.3%; $P < 0.001$) (Appendix 2).

Risk Factors

Results from a risk-adjusted binary regression predicting inpatient death are summarized in Table 3. After controlling for confounding variables, there was a higher risk of inpatient mortality in patients over 55 years of age (OR 2.116; 95% CI, 1.3-3.3; $P = 0.001$) and women (OR 1.319; 95% CI, 1.0-1.6; $P = 0.030$). There was a lower mortality risk in private insurance carriers compared to Medicare/Medicaid beneficiaries (OR 0.438; 95% CI, 0.3-0.6; $P < 0.001$), as well as in patients who presented from another health care facility compared to those who came from their home or non-health care facility (OR 0.699; 95% CI, 0.5-0.9; $P = 0.019$). Race (BIPOC vs NHW) was not predictive of inpatient death on univariable analysis (OR 0.771; 95% CI, 0.4-1.2; $P = 0.283$).

DISCUSSION

Despite advancements in cardiovascular care, disparities exist between BIPOC and NHW patients in the management of AMI.⁹

Table 1. Demographics for Wisconsin Heart Attacks in 2016

Variable	Non-Hispanic White (n = 6002) Frequency (%)	BIPOC (n = 546) Frequency (%)	P value ^a
Age (years) at admission ^b	68 (21–104)	59 (25–104)	<0.001 ^c
Age Group			<0.001 ^c
> 55 years	4856 (80.9)	326 (59.7)	
≤ 55 years	1146 (19.1)	220 (40.3)	
Sex			0.066
Male	3799 (63.3)	324 (59.3)	
Female	2202 (36.7)	222 (40.7)	
Admission type			<0.001 ^c
Emergency	3248 (54.1)	407 (74.5)	
Urgent	2509 (41.8)	123 (22.5)	
Trauma center	14 (0.2)	—	
Non-urgent	224 (3.7)	16 (2.9)	
Median household income			<0.001 ^c
First quartile	1357 (22.6)	319 (58.4)	
Second quartile	1812 (30.2)	97 (17.8)	
Third quartile	1538 (25.6)	62 (11.4)	
Fourth quartile	1256 (20.9)	64 (11.7)	
Missing	39 (0.6)	4 (0.7)	
Insurance status			<0.001 ^c
Medicare	3628 (60.4)	231 (42.3)	
Medicaid	325 (5.4)	133 (24.4)	
Private	1824 (30.4)	146 (26.7)	
Self-pay	129 (2.1)	28 (5.1)	
Other	96 (1.6)	8 (1.5)	
Point of origin for admission			<0.001 ^c
Non-health care facility	3282 (54.7)	403 (73.8)	
Health care facility transfer	2563 (42.7)	133 (24.4)	
Missing	157 (2.6)	10 (1.8)	

Abbreviations: BIPOC, Black, Indigenous, and People of Color.
^aChi-square or *t* test.
^bMedian (range).
^cSignificant.

It is suggested that eliminating racial disparity may prevent nearly 1 million annual hospitalizations.¹⁰ For states with high rates of admissions for AMI, the identification and elimination of disparity may have cost-savings implications, while also facilitating the provision of equitable care.

Few nationwide studies suggest Black and Hispanic inpatients are younger than NHW inpatients admitted for AMI.^{1,11–14} The current study found BIPOC inpatients in Wisconsin were younger, with a median age of 59 years compared to 68 years in NHW inpatients. This finding aligns with trends in the literature. When grouped by individual race, the age gap was not significantly different between Hispanic and NHW inpatients (57 years vs 68 years, respectively; *P* = 0.521), nor between Black and NHW inpatients (58 years vs 68 years, respectively; *P* = 0.061). Thus, the observed age gap appears to be a disparity that is also present at the national level and not specific to Wisconsin.

In a CMS study of over 2 million AMI hospitalizations, Black inpatients also were more likely than NHW inpatients to be women.¹⁴ In the current study, the rate of women admitted for AMI was similar between BIPOC and NHW inpatients (36.7% and 40.7%, respectively). However, when grouped by individual race, there was a larger proportion of Black women admitted for AMI (48.6%) than NHW women (36.7%), which again aligns with national trends (Table 4). Additionally, the proportion of Hispanic women admitted for AMI was lower than NHW women (30% vs 36%), though this gap has not been described at the national level.

In addition to other demographic data presented herein, the current study found a significant independent association between primary expected payer (insurance status) and race. Most NHW inpatients were enrolled in Medicare (60.4%), while only 5.4% were enrolled in Medicaid. In contrast, 42% of BIPOC inpatients had Medicare, while nearly 25% had Medicaid. Thus, BIPOC patients were more often insured by Medicaid, which some studies suggest may result in a compromised quality of inpatient care.^{2,15}

The proportion of patients from higher and lower income neighborhoods was similar between each group. However, the point of origin for admission—or where these patients were transferred from—was different. NHW inpatients had a higher rate of transfer from another health care entity than did BIPOC inpatients (37.4% vs 18.9%). Additionally, BIPOC inpatients more often presented from the community than did NHW inpatients (73.8% vs 54.7%). These findings suggest disparity may exist in the quality of care leading up to admission for AMI. Though the SID does not list the specific location of origin, it is presumed any non-health care facility refers to the general community. Possible explanations for this disparity include different comorbidities between groups, disparities in socioeconomic factors, insufficient preventive medicine, or lack of access to high-quality care among the BIPOC population. Furthermore, these findings also might

Table 2. Hospital Outcomes for Wisconsin Heart Attacks in 2016

Variable	Non-Hispanic White (n = 6002) Frequency (%)	BIPOC (n = 546) Frequency (%)	P value ^a
Length of stay (days) ^b	3.87 (4.567)	4.36 (5.934)	0.021 ^c
Total charges (USD) ^b	65,384 (64,665)	74,716 (87,286)	0.002 ^c
Mortality (in-hospital death)			0.282
Yes	268 (4.5)	19 (3.5)	
No	5734 (95.5)	527 (96.5)	
Disposition			0.001 ^c
Home health	4286 (71.4)	415 (76.0)	
Skilled nursing facility	517 (8.6)	22 (4.0)	
Other (including death)	1179 (19.6)	106 (19.4)	
Missing	20 (0.3)	3 (0.5)	

Abbreviations: BIPOC, Black, Indigenous, and People of Color; USD, US dollars.
^aChi-square or *t* test.
^bMedian (range).
^cSignificant.

highlight insufficient preventive efforts and medication adherence among BIPOC patients, though these two issues may be influenced by the prevalence of risk factors, actual access to medications, and complex environmental and social factors. It appears these disparities are also systemic (nationwide) and not specific to Wisconsin.^{3,16,17}

The causes of racial and ethnic disparity in AMI are poorly understood. The mortality rates between NHW and BIPOC inpatients for AMI appear to differ at the national level. This statewide study, believed to be the first of its kind, found a lower mortality rate among BIPOC hospitalized for AMI (3.5%) compared to NHW inpatients (4.5%), though the difference was not statistically significant. Furthermore, the risk of inpatient mortality was not higher in the BIPOC group. Therefore, a consensus is not clear, and the rates may simply differ based on sample power. Interestingly, a lower mortality rate among BIPOC with AMI has been described previously, though the reason for this discrepancy is not known.¹⁸⁻²¹ It is possible that BIPOC have a predisposition to lower in-hospital mortality, especially if they are admitted at a younger median age with less comorbid disease. However, an early mortality advantage in BIPOC does not appear to persist following discharge, according to other data.¹⁹ To definitively confirm any changes in risk of mortality following discharge in Wisconsin, follow-up is needed at the state level. With respect to comorbid disease, an accurate representation is necessary to identify potential confounders for hospital outcomes. It would be necessary to detail every comorbidity along with the primary admitting diagnosis, though given the nature of data recording in the SID, such analysis was not feasible in this study. Unlike the primary ICD-10 admission code, which is recorded consistently, comorbidities are not readily identifiable within this dataset.

Another specific limitation of the SID is lack of data regarding follow-up and readmission, as well as treatment for AMI given during the hospitalization. These data would be necessary to assess survival rates of BIPOC versus NHW patients following discharge, as well as highlight discrepancy in specific treatment while still in the hospital. Nonetheless, this review is unique in that it identifies disparity on the state level and presents up-to-date information. As mentioned above, BIPOC inpatients were younger. However, they also incurred higher mean total inpatient charges compared to NHW inpatients for AMI, as well as longer hospital lengths of stay. BIPOC inpatients also presented more commonly as an emergency compared to NHW inpatients; this fact, as well as age, could explain the length of stay discrepancy and increased costs. When grouped by individual race, these findings remained true for both Black and Hispanic inpatients when compared to NHW inpatients. It is difficult to explain why BIPOC have longer hospital stays and incur higher charges than NHW, though this may be related to a younger median age and perhaps a more aggressive treatment in such patients.

Table 3. Risk of Inpatient Mortality for Heart Attacks in Wisconsin

Variable	Univariable		Multivariable	
	OR (95% CI)	P value	OR (95% CI)	P value
Age Group				
≤ 55 years	Ref	Ref	Ref	Ref
> 55 years	3.292 (2.1-5.1)	<0.001	2.116 (1.3-3.3)	0.001 ^a
Point of origin				
Health care facility	Ref	Ref	Ref	Ref
Non-health care facility	0.620 (0.5-0.8)	<0.001	0.699 (0.5-0.9)	0.019 ^a
Admission type				
Emergency	Ref	Ref	Ref	Ref
Other	0.669 (0.5-0.8)	0.002	0.766 (0.5-1.0)	0.073
Sex				
Male	Ref	Ref	Ref	Ref
Female	0.603 (0.4-0.7)	<0.001	1.319 (1.0-1.7)	0.030 ^a
Insurance status				
Governmental	Ref	Ref	Ref	Ref
Private/self-pay	0.312 (0.2-0.4)	<0.001	0.438 (0.3-0.6)	<0.001 ^a
Race				
Non-Hispanic White	Ref	Ref	—	—
BIPOC	0.771 (0.5-1.2)	0.283		
Individual race				
Non-Hispanic White	Ref	Ref	—	—
Black	0.7 (0.4-1.4)	0.301	—	—
Hispanic	0.173 (0.1-1.2)	0.081	—	—
Asian or Pacific Islander	1.8 (0.8-4.3)	0.158	—	—
Native American	1.126 (0.4-3.6)	0.842	—	—

Abbreviations: BIPOC, Black, Indigenous, and People of Color. OR, odds ratio; CI, confidence interval; Ref, referent variable.

^aSignificant on multivariable analysis only.

Table 4. Racial Subgroups for Wisconsin Heart Attacks in 2016

Demographic/ Outcome	Non-Hispanic White (n = 6002) Frequency (%)	Black (n = 284) Frequency (%)	Hispanic (n = 125) Frequency (%)	P value ^a
Age (years) at admission	68 (25-104)	57 (25-104)	58 (32-92)	<0.001 ^c
Sex				<0.001 ^c
Male	3799 (63.3)	146 (51.4)	87 (69.6)	
Female	2202 (36.7)	138 (48.6)	38 (30.4)	
LOS (days)	3.87 (4.567)	4.61 (6.09)	4.40 (7.37)	0.018 ^c
Total charges (USD)	65,384 (64,665)	72,567 (83,627)	83,912 (111,655)	0.002 ^c
Insurance status				<0.001 ^c
Medicare	3628 (60.4)	127 (44.7)	44 (35.2)	
Medicaid	325 (5.4)	79 (27.8)	27 (21.6)	
Private	1824 (30.4)	64 (22.5)	38 (30.4)	
Self-pay	129 (2.1)	11 (3.9)	14 (11.2)	
Other	96 (1.6)	3 (1.1)	2 (1.6)	

Abbreviations: NHW, non-Hispanic White; LOS, length of stay; USD, US dollars.

^aChi-square test or 1-way ANOVA.

^bMedian (range).

^cSignificant.

^dMean (standard deviation).

However, it may also indicate a role for earlier intervention in BIPOC patients with certain risk factors, which may reduce the admission burden and lower costs through shorter hospital stays in this population.

It is important to identify ways that this study and its results might be extended directly to the community. This study found demographic disparity between NHW and BIPOC inpatients for AMI, as well as disparity in hospitalization charges and lengths of stay. However, there was not a higher risk of mortality in BIPOC overall, which means these differences did not cause more in-hospital deaths. However, mortality (or death) risk was higher in women and patients over 55 years of age, who historically have worse outcomes in AMI. These latter findings are certainly important, nonetheless.

The SID does not record the entirety of AMI admissions throughout any given year, though its volume is amenable to study of admission rates by county. For NHW inpatients, Manitowoc County (ZIP code 54220) had the highest rate of hospitalization for AMI (1.2%), followed by Sheboygan (53081, 1.2%) and La Crosse (54601, 1.1%) counties. For BIPOC inpatients, Milwaukee County (53206-9, 53212, 53216-8, 53223-5, 53204, 53208, 53210) had the highest hospitalization rate for AMI (41.3%), followed by Rock County (53511, 2.0%) (Appendix 2). While there is likely a larger population of BIPOC in Milwaukee than other counties, this independent association is significant. It is hopeful these findings might inspire future community-driven efforts within such regions or populations or give new evidence-based motivation to studies already in existence.

Presently, there are no “next steps” through which these findings will be disseminated to the community, though the implications might promote future goal-oriented research efforts. The results of this study highlight the importance of interventions outside of health care for reducing the financial, social, and individual costs associated with AMI. Interestingly, there are national trends that suggest some disparities are decreasing.⁹ However, there are still opportunities for change and improvement for the entire health care system, including providers and patients alike. This change may be difficult, but such interventions are necessary to initiate change at a statewide level. As mentioned, there are no next steps from this study currently, though interventions such as health policy changes at a statewide level, quality improvement programs at a local or county level, and perhaps even clinical and culturally targeted community interventions may offer hope that some of the observed discrepancies can be mitigated in Wisconsin. Culturally targeted community interventions may be particularly important to educate different patient groups on the risk factors of heart attacks and advise on how basic preventive measures can be employed to reduce the risk of hospitalizations. Such measures also can be taken in the clinic, an area ripe for patient education.

Limitations

There are inherent limitations to this study, most of which stem from using a large, collaborative dataset. While a few of these limitations are mentioned above, it is necessary to highlight the heterogeneous nature of this entire cohort with respect to different races, ages, ZIP codes, and insurance providers. Thus, error may exist with respect to confounding variables, especially as the 2 comparative groups were not control-matched. There also may exist variability in body mass index, comorbid disease such as diabetes, smoking, and drinking, as well as in provider entry habits to the SID. Though given the nature of the SID dataset, these variables were not available for inclusion.

A second limitation of this study is the generalizability of the results. Notably, the term “minority” has been used previously in national datasets; in this study, it was used similarly but referred to as BIPOC. However, different institutions may describe this group using different terminology or may include different races than the ones included in this study. Thus, the findings of the current study must be interpreted accordingly.

CONCLUSION

It appears BIPOC inpatients have longer hospital stays and incur higher charges compared to NHW inpatients, though race does not appear to influence the inpatient mortality risk. This study also recorded demographic differences that exist between racial and ethnic groups. Among Wisconsin counties with higher proportions of AMI, these data may enable strategic recommendations of hospitalized patients or permit hospital-specific risk stratification to identify disparity and encourage equitable care.

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