Percutaneous Coronary Intervention in the United States: Risk Factors for Untimely Access

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Objective. To determine how access to percutaneous coronary intervention (PCI) is distributed across demographics.

Data Sources. Secondary data from the 2011 American Hospital Association (AHA) survey data combined with 2010 Census.

Study Design. We calculated prehospital times from 32,370 ZIP codes to the nearest PCI center. We used a multivariate logit model to determine the odds of untimely access by the ZIP code's concentration of vulnerable populations.

Data Collection. We used ZIP code-level data on community characteristics from the 2010 Census and supplemented it with 2011 AHA survey data on service-line availability of PCI for responding hospitals.

Principal Findings. For approximately 306 million Americans, the median prehospital time to the nearest PCI center is 33 minutes. While 84 percent of Americans live within one hour of a PCI center, the odds of untimely access are higher in low-income (OR: 3.00; 95 percent CI: 2.39, 3.77), rural (8.10; 95 percent CI: 6.84, 9.59), and highly Hispanic communities (2.55; 95 percent CI: 1.86, 3.49).

Conclusions. While the majority of Americans live within 60 minutes of a PCI center, rural, low-income, and highly Hispanic communities have worse PCI access. This may translate into worse outcomes for patients with acute myocardial infarction.

Key Words. Myocardial infarction, disparities

Coronary heart disease, including acute myocardial infarction (AMI), is among the leading causes of death worldwide. ST-elevation myocardial infarction (STEMI), in particular, is the deadliest subtype of AMI with a mortality rate of 12 percent (Fox 2004). STEMI affects 500,000 Americans every year (Antman et al. 2004), for whom timely access to percutaneous coronary intervention (PCI) is critical to achieving better outcomes (Keeley and Grines 2004). Due to the resource intensity of the procedure, however, only 37 percent of all acute care, adult hospitals in the United States offer any PCI lab

capability (Concannon et al. 2013). In addition, less than 12 percent (574 of 4,931) of all hospitals offer PCI for a high volume of STEMI patients (>40 primary PCI annually), with even fewer of these supporting round-the-clock availability (Wang and Yealy 2012).

Recent literature looking at geographic access to PCI in the United States has shown that many new PCI services are open in competitive markets, often with high private insurance penetration, where patients already have access to PCI (Concannon et al. 2013; Langabeer et al. 2013). These studies question whether PCI services effectively reach patients who could benefit from better access to catheterization.

While access to PCI has been studied for the general population (Concannon et al. 2012; Langabeer et al. 2013), experts have not analyzed and highlighted whether access to existing PCI centers is equitably distributed among socioeconomic, racial/ethnic, and geographic (urban/rural) groups (Girotra and Cram 2012). This is particularly important given well-documented disparities in revascularization and outcomes for minority and socioeconomically disadvantaged patients with AMI (Whittle et al. 1993; Alter et al. 1999; Bradley et al. 2004; Vaccarino et al. 2005; Mehta et al. 2006; Guzman et al. 2012). For instance, past research has shown that black patients have 38 percent lower odds of receiving PCI and are approximately 10 percent less likely to receive any reperfusion therapy than white patients (Whittle et al. 1993; Vaccarino et al. 2005), and that 69 percent of Hispanic STEMI patients receive primary PCI within 90 minutes of hospital arrival, compared to 78 percent of non-Hispanic whites (Guzman et al. 2012). While differences in patient preference, insurance status, or education are potential drivers of these disparities (Schechter et al. 1996), poor geographic access to PCI centers could also explain why revascularization rates, in particular, are lower for these vulnerable populations.

To eliminate health and health care disparities, as suggested by Healthy People 2020 (U.S. Department of Health and Human Services 2010), the Department of Health and Human Services Disparities Action Plan (U.S. Department of Health and Human Services—Office of Minority Health 2011), and the Patient Protection and Affordable Care Act of 2010 (U.S.

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Congress 2010), it is vital to document baseline access to life-saving procedures, such as PCI, by demographic groups before interventions can be targeted appropriately. Our study seeks to (1) provide the most current data available on the general population's access to PCI in the United States as measured by prehospital time to the nearest PCI center; and (2) determine whether certain vulnerable population groups have increased risks for experiencing untimely access to PCI.

METHODS

Data Sources

As the basis of our study, we used ZIP code-level data on community characteristics and population-weighted central geocodes (longitudes and latitudes) from the 2010 Census. We supplemented this ZIP code dataset with the 2011 American Hospital Association (AHA) survey data on service-line availability of PCI for responding hospitals. Furthermore, we identified the hospitals' geocodes using a combination of the 2011 AHA survey data and heliport data collected for a previous study.

To more accurately identify PCI centers and minimize the chance of sporadic reporting errors in 2011, we also used AHA data from 2000 to 2010 to determine if a hospital's reported PCI availability in 2011 is valid, using a definition of health care technology adoption from previous literature (Baker and Phibbs 2002; Hsia, Kellermann, and Shen 2011). We designated the first year of the first consecutive pair of years where the data show the hospital offers a given service as the "adoption year." We only considered a hospital as a PCI center beginning the year following the adoption year. Thus, hospitals that first report PCI availability in 2011 are not considered PCI-capable in our analysis.

Finally, because Alaska and Hawaii have unusual topography for which our distance calculations would be highly imprecise (e.g., cases in Alaska where the straight-line distance between a ZIP code center and the nearest PCI-capable hospital is only 20 or 30 miles, but because of limited road availability it may actually take more than a day of travel), we chose to study PCI availability within the continental United States, excluding Alaska and Hawaii. This is consistent with previous work on access to other acute services such as emergency departments (Shen and Hsia 2010; Hsia and Shen 2011).

Outcome

Our access measure is “projected access,” as we are working from simulated and not observed prehospital transport, and our central outcome measure is prehospital time from each ZIP code to the nearest PCI center in 2011. Pre-hospital time consists of the following components: time to obtain ambulance dispatch, driving time from the ambulance depot to the patient, time spent on scene, and drive time from the patient to the nearest PCI center. We obtained actual driving time between a ZIP code’s population-weighted central geocode and the nearest PCI center’s geocode using a programming interface between Stata and Google Maps (Ozimek and Miles 2011). We multiplied this driving time by a factor of 1.6 for urban areas and 1.4 for rural areas to obtain the overall round-trip driving times (from ambulance depot to patient to PCI center). These constants were adapted from prior similar analyses (Branas et al. 2005; Nallamothu et al. 2006). Furthermore, we added 1.4 minutes for ambulance dispatch in urban areas and 2.9 minutes in rural areas; we also added 8 minutes for time spent on scene in urban areas and 9 minutes in rural areas (Nallamothu et al. 2006).

Also based on previous literature, we chose a standard cut point of 60 minutes as the timeframe for prehospital transport that maximizes the possibility of achieving the most benefit from PCI (Nallamothu and Bates 2003; Nallamothu et al. 2006). We categorized patients as having “timely” (≤ 60 minutes prehospital time) and “untimely” (> 60 minutes) access to PCI based on this definition.

Vulnerable Populations

On the basis of previous literature (Hsia and Shen 2011), we specifically examined how a community’s distribution of low-income residents, racial or ethnic minorities (black, Hispanic, and other minority), foreign-born populations, and elderly residents (≥ 65 years old) predicted its access to PCI care. We defined each of these predictors using standardized variables from the US Census Bureau. Specifically, race/ethnicity is self-classified according to the standard Census Bureau categorizations; we define the “other minority populations” category as combination of residents selecting American Indian or Alaskan Native, Native Hawaiian or Other Pacific Islander, Asian, or “some other race.”

We divided all communities into three categories based on the distribution of a given subpopulation. For example, if the percentage of a

community's Hispanic population was at the upper one-third of the entire Hispanic population distribution for all communities, it was defined as having a "high" share of Hispanics; "medium" share if the percentage of Hispanics fell in the middle one-third of the distribution; and "low" share if the percentage was in the lowest one-third of the distribution.

We also examined whether residing in rural areas was a risk factor for worse PCI access, as rural residents have been shown to be less likely to receive revascularization (Abrams, Vaughan-Sarrazin, and Kaboli 2010). We classified a ZIP code as urban if it was in a Metropolitan Statistical Area, and rural if it was not. Finally, we included indicators for Census divisions to control for baseline PCI access differences across the nine regions. All of these classifications were included in our multivariate model to compare the PCI access of each community within otherwise similar conditions.

Statistical Methods

We used the community, as defined by 2010 ZIP codes, as the unit of analysis, and descriptively compared population characteristics between communities with timely access to PCI centers and those with untimely access. We subsequently employed a multivariate logit model to analyze the odds of having untimely access to PCI as opposed to timely access for each subgroup of our previously defined vulnerable populations, controlling for all other factors described above. All analyses are weighted by each community's population size so that the estimates are representative of the U.S. population. All estimations were implemented in Stata 13 (College Station, TX, USA). This study was exempted from the Committee on Human Research at the University of California, San Francisco.

RESULTS

Our study includes a total of 1,738 PCI centers in 2011. Across 32,370 ZIP codes, representing 306 million Americans, the median prehospital time to the nearest PCI center is 33 minutes (interquartile range [IQR]: 25, 49).

We found that 52 percent of communities have "timely" access to PCI, and 48 percent have "untimely" access. Because of the population density of urban centers, however, 83.7 percent (256 million) of the U.S. population falls into the category of timely access, while only 16.3 percent (50 million) live over 60 minutes from the nearest PCI center (Table 1).

Table 1: Community Characteristics of ZIP Codes in Study Sample

Variable	All ZIP Codes in Analysis		Timely Access (≤ 60 Minutes Prehospital Time)		Untimely Access (> 60 Minutes Prehospital Time)	
	% of ZIP Codes	Median Prehosp Time (Minutes)	% of ZIP Codes	Median Prehosp Time (Minutes)	% of ZIP Codes	Median Prehosp Time (Minutes)
Overall sample	100	33.4	52	30.2	48	80.5
<i>Community characteristics</i>						
Income distribution						
High income (ref group)	33	31.8	38	30.2	10	71.8
Medium income	33	35	33	31.5	36	77.7
Low income	33	33.4	29	27	54	83.3
Hispanic population						
Low share (ref group)	33	41.4	29	35	54	79.8
Medium share	33	31.8	35	30.2	24	79.1
High share	33	28.6	35	27	22	83.3
Black population						
Low share (ref group)	33	44.6	28	35	62	84.6
Medium share	33	30.2	36	28.6	19	74.9
High share	33	30.2	36	28.6	20	76.6
Other race						
Low share (ref group)	33	44.6	29	36.6	57	78.2
Medium share	33	31.8	35	30.2	24	81.4
High share	33	27	36	27	18	86.2
Foreign born						
Low share (ref group)	33	47.8	27	37.1	68	80.5
Medium share	33	31.8	36	30.2	22	81.9
High share	33	27	38	27	11	78.2
Elderly population						
Low share (ref group)	33	30.2	37	30.2	16	78.2
Medium share	33	31.8	34	30.2	28	76.3
High share	33	38.2	29	30.2	56	83
Population size	9,463		15,212		3,213	
Number of ZIP code communities	32,370		16,859		15,511	
Population count	306,294,581		256,457,620		49,836,961	

The median prehospital time to reach the nearest PCI-capable hospital is 30 minutes (IQR 24, 39) for residents with timely access, while Americans with untimely access need 81 minutes (IQR 68, 103).

Of communities with untimely access, 54 percent are considered low income, compared to 29 percent of communities with timely access (Table 1). ZIP codes with untimely access to PCI also have lower shares of minority populations. Further, more ZIP codes with untimely access to PCI (56 percent) than ZIP codes with timely access (29 percent) have a high concentration of elderly residents. Geographically, 66 percent of ZIP codes with untimely access to PCI are in rural areas.

The majority of rural residents (58 percent) live more than 60 minutes away from a PCI center (see Table 2; Appendix SA2). Rural residents have a median driving time of 67 minutes to their nearest PCI center, while urban residents have a median driving time of 30 minutes. In addition, prehospital time is right skewed for both types of communities, as shown in the Appendix SA2. The skewness is mainly driven by driving time. In some communities where distance to PCI is close, driving time represents a small percent of the total prehospital time, whereas in communities that are far away from PCI, driving time presents a large percent of total prehospital time. The East South Central (Tennessee, Kentucky, Alabama, Mississippi) and West North Central (Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota) census divisions have the overall highest median prehospital times of 43 and 38 minutes, respectively (Table 2). Figure 1 shows the distribution of prehospital time in minutes for rural and urban communities overall and by census division.

In our multivariate logistic regression (Table 3), not surprisingly, rural communities have eight times the odds of untimely access compared with urban communities (OR 8.10, 95 percent CI 6.84, 9.59). However, even holding urbanicity and rurality constant, low-income and middle-income communities still have significantly higher odds of untimely access to PCI compared to high-income communities (OR 3.00, 95 percent CI 2.39, 3.77; OR 1.88, 95 percent CI 1.49, 2.36, respectively). In other words, low-income communities in urban areas compared with high-income urban communities are at higher risk of poorer access. Likewise, communities with the highest tertile of Hispanic residents also have higher adjusted odds of untimely access to PCI (OR 2.55, 95 percent CI 1.86, 3.49). ZIP codes that appeared to have better access to PCI included those with higher shares of black residents, other minorities, and foreign-born populations.

Table 2: Descriptive Characteristics of Urban and Rural Population Access to Nearest Percutaneous Coronary Intervention Center

<i>Census Division</i>	<i>2010 Census Population Count</i>		<i>Percent with > 60 Minutes Prehospital Time to Closest PCI Hospital</i>			<i>Median Prehospital Time (in Minutes)</i>		
	<i>Urban</i>	<i>Rural</i>	<i>Urban (%)</i>	<i>Rural (%)</i>	<i>Total (%)</i>	<i>Urban</i>	<i>Rural</i>	<i>Total</i>
New England	12,694,517	1,739,183	4	67	12	32	76	33
Mid-Atlantic	37,467,415	3,399,323	5	55	9	27	62	29
East North Central	37,153,045	9,260,477	4	50	13	29	60	32
West North Central	12,763,106	7,730,782	9	69	32	30	76	38
South Atlantic	48,300,786	11,311,119	5	44	13	33	57	35
East South Central	11,160,832	7,311,746	10	56	28	35	64	43
West South Central	29,197,047	7,106,233	6	62	17	30	69	33
Mountain	17,047,171	4,900,349	13	76	27	30	117	35
Pacific	44,440,557	3,310,893	10	74	14	29	92	30
Total	250,224,476	56,070,105	7	58	16	30	67	33

DISCUSSION

Our findings show that the median prehospital time from a patient's resident ZIP code to his or her nearest PCI center is 33 minutes, and that 84 percent of the U.S. population lives within 60 minutes of a PCI-capable hospital. However, almost 50 million residents still live greater than 1 hour from the nearest PCI center, with a median prehospital time of 81 minutes.

Compared to a previous study that analyzed PCI access in 2000 (Nallamothu et al. 2006), our descriptive results show that access to PCI remains similar after a decade—the median distance to a PCI-capable hospital only slightly declined from 7.9 miles in 2000 to 7.4 miles in 2011, and the percent of the population with access to PCI within 60 minutes increased marginally from 79 percent to 84 percent.

Our multivariate results contribute a new layer to the literature by showing that PCI access is extremely uneven across segments of the population. In particular, rural, low-income, and highly Hispanic communities have worse access to PCI after other demographic characteristics of the communities are held constant. It is important to remember that these factors are independently associated with a higher likelihood of having poorer access; in other words, even when urbanicity and rurality are held constant, low-income and highly Hispanic communities independently have worse access to PCI. These

Figure 1: Median Prehospital Time (in Minutes) to Nearest Emergency Department for Urban and Rural Communities, Overall and by Census Division

Note. Central lines represent the median prehospital times, and the encompassing boxes represent the interquartile range. The whiskers represent the 5th and 95th percentiles.

results, along with existing literature that documents the importance of geographic proximity in accessing available health care services, may also provide a partial explanation for why disparities in revascularization and even mortality for certain populations—including poorer (Alter et al. 1999), Hispanic (Bradley et al. 2004), and rural residents (Abrams, Vaughan-Sarrazin, and Kaboli 2010; Bhuyan 2013)—exist. Findings from recent literature support the idea that the growth in PCI centers, which may be seen as largely market-oriented, has exceeded that of population growth, and that there is excess PCI capacity in some areas compared with inadequate access in others (Concannon et al. 2013; Langabeer et al. 2013).

We also found that, similar to other studies, communities with a higher proportion of blacks had better access to PCI hospitals compared with communities with a lower proportion of blacks. Despite this, blacks have a lower likelihood of receiving PCI for AMI compared to white patients, and studies have shown that blacks are less likely to choose and be admitted to such hospitals for AMI treatment when compared to their white counterparts

Table 3: Logistic Regression Results on Odds of Having Untimely Access to Percutaneous Coronary Intervention Centers

	<i>Multivariate Results Odds Ratio (95% CI)</i>
<i>Community characteristics</i>	
Income distribution	
High income (ref group)	1.00 (1.00, 1.00)
Medium income	1.88** (1.49, 2.36)
Low income	3.00** (2.39, 3.77)
Hispanic population	
Low share (ref group)	1.00 (1.00, 1.00)
Medium share	0.99 (0.83, 1.19)
High share	2.55** (1.86, 3.49)
Black population	
Low share (ref group)	1.00 (1.00, 1.00)
Medium share	0.45** (0.33, 0.62)
High share	0.37** (0.23, 0.61)
Other minority population	
Low share (ref group)	1.00 (1.00, 1.00)
Medium share	0.79* (0.63, 0.99)
High share	0.59* (0.36, 0.95)
Foreign-born population	
Low share (ref group)	1.00 (1.00, 1.00)
Medium share	0.39** (0.34, 0.45)
High share	0.15** (0.10, 0.22)
Elderly population	
Low share (ref group)	1.00 (1.00, 1.00)
Medium share	0.96 (0.72, 1.28)
High share	1.25 (0.88, 1.77)
<i>Geographic characteristics</i>	
Metropolitan statistical area	
Urban communities (ref group)	1.00 (1.00, 1.00)
Rural communities	8.10** (6.84, 9.59)
Census divisions	
New England (ref group)	1.00 (1.00, 1.00)
Mid-Atlantic	0.97 (0.89, 1.06)
East North Central	0.57** (0.53, 0.62)
West North Central	1.54** (1.46, 1.62)
South Atlantic	1.12 (0.85, 1.48)
East South Central	1.16 (0.94, 1.44)
West South Central	1.36** (1.16, 1.61)
Mountain	2.59** (2.35, 2.84)
Pacific	3.60** (3.03, 4.28)
Constant term	0.10** (0.07, 0.15)
N	32,341

Note. * $p < 0.05$; ** $p < 0.01$.

(Popescu, Cram, and Vaughan-Sarrazin 2011). Other studies have shown that even after adjusting for home-to-hospital distance, certain minority groups are less likely to travel to high-technology hospitals (Blustein and Weitzman 1995). Taken together, these studies suggest that geographic proximity to centers offering revascularization is not the sole factor in determining access to care.

What policy implications can we draw from these findings? There is clearly a limit to the economic viability of fixed infrastructure such as a cardiac catheterization facility in terms of a minimum population level served to be financially viable and minimum service levels to be clinically proficient. Given that the American College of Cardiology and American Heart Association recommends that first medical contact-to-device times be no more than 120 minutes (O’Gara et al. 2013), and knowing that delays in transferring patients are often inevitable, certain communities with untimely access may need to create protocols and networks that are able to achieve the maximal benefit for their populations. It is critical that health care workers in these communities acknowledge these realities—for example, according to analysis of a national registry, less than 9 percent of patients experienced a door-to-balloon time of less than 90 minutes among patients who were transferred for primary PCI (Chakrabarti et al. 2008). Communities with limited access may therefore consider instituting protocols that acknowledge the benefit of timely fibrinolytic therapy (specifically within 30 minutes, as recommended by the ACC and AHA) (O’Gara et al. 2013) when anticipated transfer times (based on actual and historical times) exceed recommended guidelines for appropriate patients. This could occur even in the field, as numerous randomized controlled trials have documented the feasibility of administering thrombolytics safely in this environment with significant mortality benefit (Castaigne et al. 1989; The European Myocardial Infarction Project Group 1993; Morrison et al. 2000; Bonnefoy et al. 2002).

Aeromedical transport to PCI-capable hospitals has been described (Bellinger et al. 1988; Knudsen et al. 2012) and is practiced in some areas. Yet there are numerous concerns regarding the cost-effectiveness of helicopter transport overall (Taylor et al. 2010; Delgado et al. 2013), and given the paucity of evidence for air transport for PCI patients, this strategy is not mentioned by either the ACC or AHA in their recommendations.

One larger mechanism encompassing these changes for improving access and outcomes for these residents could be through regionalization of STEMI care (Jollis et al. 2007). It is possible that the organized routing and presence of transfer protocols inherent in regionalization may not only reduce

transport times by directly routing patients to PCI hospitals (or allowing for protocolized administration of thrombolytics when appropriate) but also to some extent mitigate factors such as knowledge of options, provider referral preferences, and patient preferences (Finlayson 2006) that may keep them in a non-PCI hospital during a STEMI care situation. Recent evidence on the effect of PCI regionalization on health disparities is limited and inconclusive (Glickman et al. 2010), and further evaluation is needed to determine whether regionalization protocols can be an effective tool to address disparities in cardiovascular care.

Regionalization and other system-level innovations, which are often implemented through regulation, may be necessary to reach underserved myocardial infarction patients, as the market does not appear to be naturally addressing these disparities in access. In fact, recent evidence has shown that PCI programs are preferentially introduced in larger and more affluent hospitals, in areas with a more attractive payer mix (e.g., private insurance) and market competition, often resulting in duplicative services (Concannon et al. 2013; Horwitz et al. 2013; Langabeer et al. 2013). The “appropriate” levels of PCI capacity have been debated in the literature; measures such as number of PCI hospitals per capita, while presenting one aspect of access, do not capture the fact that rural areas will have a higher density of PCI centers as they need to balance geographic accessibility (Girotra and Cram 2012; Langabeer et al. 2013). While it may not be feasible to introduce new PCI programs—which can cost an estimated \$8 to \$16 million—in all underserved communities, our findings of uneven PCI access, along with recent literature, suggest that the current, largely market-driven increases in PCI alone may not be addressing disparities in access to care.

Limitations

There are several limitations of our study. First, we relied upon the AHA’s survey data to determine PCI capability at U.S. hospitals, which is based on hospital self-report of available services. While accreditation for cardiac/PCI centers does exist (e.g., Accreditation for Cardiovascular Excellence Cath/PCI, American Heart Association STEMI receiving or referring center accreditation), these are expensive for hospitals to obtain and therefore have a very small market penetration. The National Cardiovascular Data Registry CathPCI registry captures a much larger number of PCI-capable hospitals, but it is still less comprehensive than the AHA survey we employ. Even based on the most current CathPCI registry available on December 17, 2013

(National Cardiovascular Data Registry 2013), there are only 1,656 hospitals with PCI capability registered, which is fewer centers than we record using our older, 2011 AHA data. We therefore follow prior literature on this subject using the AHA data (Nallamothu et al. 2006; Concannon et al. 2013) and are reassured that it has been validated in a share of the states by previous work (Concannon et al. 2012). Importantly, in the AHA data, there is no indicator for whether PCI is available on an emergent basis or only during scheduled hours (e.g., for elective procedures). As a result, these findings are necessarily conservative in that they represent the best-case scenario for patients requiring emergent catheterization services.

Second, we used the most recently available AHA data from 2011. Assuming the previous trajectory of growth of PCI in already well-served communities has continued (Concannon et al. 2013), it is likely that both our findings regarding the general population's access to PCI, as well as that of more untimely access for vulnerable population groups, are conservative estimates of the current state of PCI access, although we believe the underestimation is very small, given that most of the growth has been duplicative and has not significantly increased access. Finally, we do not include aeromedical transport in our calculations of time to nearest PCI center. We believe this omission has no impact on this study, as such networks for STEMI are generally restricted to interhospital transport (Pitta et al. 2010).

Third, we used ZIP codes as the level of analysis instead of census tracts. This level of aggregation is commonly used in previous work examining access to health care facilities (Begley et al. 2006; Hare and Barcus 2007; Onega et al. 2008). In addition, this particular study is part of a larger work, which will link individual patient outcomes at the ZIP code level. It is important to note, however, that other important studies that examine PCI availability have been done using census tracts and also use the adult population, while ours studies the entire U.S. population. Thus, our results cannot be directly compared to Nallamothu et al.'s (2006) study due to the differences in the analysis unit, study population, and geographic distribution of children and adults.

CONCLUSIONS

While 84 percent of the U.S. population lives within 60 minutes of a PCI-capable hospital, 50 million Americans still live greater than 1 hour away from the nearest available PCI. Low-income, Hispanic, and rural communi-

ties each independently have higher odds of needing more than 1 hour to reach the nearest PCI center. The challenges of geographic proximity to PCI may be a potential mechanism linking access to revascularization and outcomes, and interventions to target reduction in the geographic barriers to care may be worthy of consideration in the planning and allocation of these life-saving services.

ACKNOWLEDGMENTS

Joint Acknowledgment/Disclosure Statement: This publication was supported by the National Institutes of Health/National Heart, Blood, and Lung Institute 1R01HL114822-01. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of any of the funding agencies.

Disclosures: None.

Disclaimers: None.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article:

Appendix SA1: Author Matrix.

Appendix SA2: Distribution of Prehospital Time to Nearest Percutaneous Coronary Intervention (PCI) Center by Urban/Rural Status.