

Hospital Characteristics Associated with the Availability of Interventional Radiology Facilities and Services

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Conflicts of interest are listed at the end of this article.

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Interventional radiology (IR) uses minimally invasive procedures to diagnose and treat a wide range of diseases while minimizing morbidity, mortality, and cost (1). Demand for IR services is high, especially among patients experiencing high-level medical complexity. Approximately 8% of adult patients admitted to the hospital in the United States require at least one IR procedure (2). Yet, little remains known about the prevalence of and hospital characteristics associated with IR facility and service availability. In this retrospective cross-sectional study, we use a question introduced in the 2020 American Hospital Association annual survey to investigate the prevalence of and hospital characteristics associated with IR facility and service availability.

Materials and Methods

Our sample included general medical and surgical hospitals that responded to the 2020 American Hospital Association survey, which had a response rate of greater than 75% and provides data on a number of organizational characteristics for more than 6000 hospitals (3). We also acquired county-level population characteristics from the Health Resources & Services Administration's 2020 Area Health Resource Files.

We excluded hospitals that did not answer the question regarding IR availability. Hospitals were asked to indicate if IR facilities and services were owned or provided by the hospital, by their health system in their local community, through an agreement with another provider in their local community, or not provided. We created a binary variable dichotomizing IR as available if hospitals indicated any choice other than not providing IR.

We used a multivariable logistic regression model to investigate associations between organizational characteristics and IR availability and to determine the percentage of hospitals with IR availability according to county and state and/or territory. Furthermore, we calculated the proportion of individuals living in counties without inpatient IR availability and estimated nearest distances between hospitals with and without IR availability. Statistical tests in RStudio (version 2022.02.3) used robust standard errors with significance defined at two-tailed $\alpha = .05$, and distances were estimated using the *sf* package (4).

Results

Our sample included 3327 hospitals that indicated whether IR facilities and services were available. Of the 3327 hospitals, 1994 (60%) reported IR as available (Table). After multivariable adjustment, larger, private nonprofit, health system member, and teaching hospitals were more likely to have IR available. Hospitals in rural areas, critical access hospitals, and sole community hospitals were less likely to have IR available. IR availability substantially varied by state and county, with 16 states or territories reporting availability in half or fewer than half of the hospitals (Figure). In 2020, an estimated 10.2% of the population ($n = 30\,274\,146$) included in the study sample lived in counties without IR availability. For hospitals without IR, the median distance to the nearest hospital with IR was 25 miles (IQR, 16–37 miles), ranging between less than a mile to 230 miles.

Discussion

Increasing availability of IR in the areas and types of hospitals identified in our study may improve outcomes for patients served at these hospitals (1). In areas where supply of interventional radiologists remains limited, general radiologists may be able to meet some of this demand (5). Studies have shown that small and rural hospitals have difficulty recruiting and retaining interventional radiologists, which results in unmet demand (6). Nonetheless, the ability of all radiologists to offer inpatient IR services remains limited by IR facility and service availability in hospitals.

A limitation of this study is that we relied on self-reported data and excluded nonreporting hospitals, which may result in biased estimates. Furthermore, the data set did not include information about the type and intensity of IR services provided, complexity of patients cared for, or outcomes that matter to patients. For instance, smaller, rural, or critical access hospitals may be less likely to care for patients requiring complex and intensive IR services. Therefore, future research should address the clinical and operational appropriateness of investing in hospital IR infrastructure.

Author contributions: Guarantor of integrity of entire study, T.C.H.; study concepts/study design or data acquisition or data analysis/interpre-

Characteristics of the 3327 Hospitals in the Study Sample and Results of Multivariable Logistic Regression Associating Availability of IR Facilities and Services to Hospital Characteristics

Characteristic	Hospitals without IR	Hospitals with IR	Adjusted Odds Ratio	95% CI	P Value
Organizational characteristics					
Hospital size					
<100 beds	1039	578	Reference	Reference	Reference
100–300 beds	233	791	2.2	1.7, 2.9	<.001
300–500 beds	52	350	2.7	1.8, 4.1	<.001
>500 beds	9	275	15	7.3, 31	<.001
Ownership structure					
Private, nonprofit	721	1548	Reference	Reference	Reference
Private, for-profit	178	192	0.3	0.2, 0.4	<.001
Government, nonfederal*	422	232	0.5	0.4, 0.7	<.001
Government, federal	12	22	0.3	0.1, 0.7	.002
Core-based statistical area [†]					
Metropolitan	471	1568	Reference	Reference	Reference
Micropolitan	291	274	0.8	0.6, 1.05	.1
Rural	571	152	0.5	0.3, 0.6	<.001
Other hospital characteristics					
Health system member	735	1569	1.8	1.4, 2.3	<.001
Critical access hospital [‡]	715	227	0.4	0.3, 0.5	<.001
Sole community hospital [§]	133	108	0.6	0.4, 0.9	.008
Teaching hospital	329	1302	1.4	1.2, 1.8	.002
County characteristics [#]					
Percentage of college graduates	22.5 ± 9.1	31.1 ± 11.3	1.01	0.99, 1.03	.19
Percentage of non-Hispanic White residents	76.8 ± 21	68.1 ± 21.3	1.0	0.99, 1.0	.42
Median household income (\$)	55 618 ± 13 067	65 889 ± 17 679	1.0	1.0, 1.0	.18
Unemployment rate (%)	6.7 ± 2.2	7.8 ± 2.2	0.99	0.92, 1.06	.82

Note.—Except where indicated, data are numbers of hospitals. Organizational characteristics data were acquired from the American Hospital Association's 2020 annual survey. County characteristics data were acquired from the 2020 Area Health Resource Files. The multivariable logistic regression model adjusts for state and/or territory. For clarity of presentation, the Table omits state- and/or territory-specific estimates. Source.—Reference 3. IR = interventional radiology.

* Nonfederal government hospitals include state, county, city, and other locally owned public hospitals.

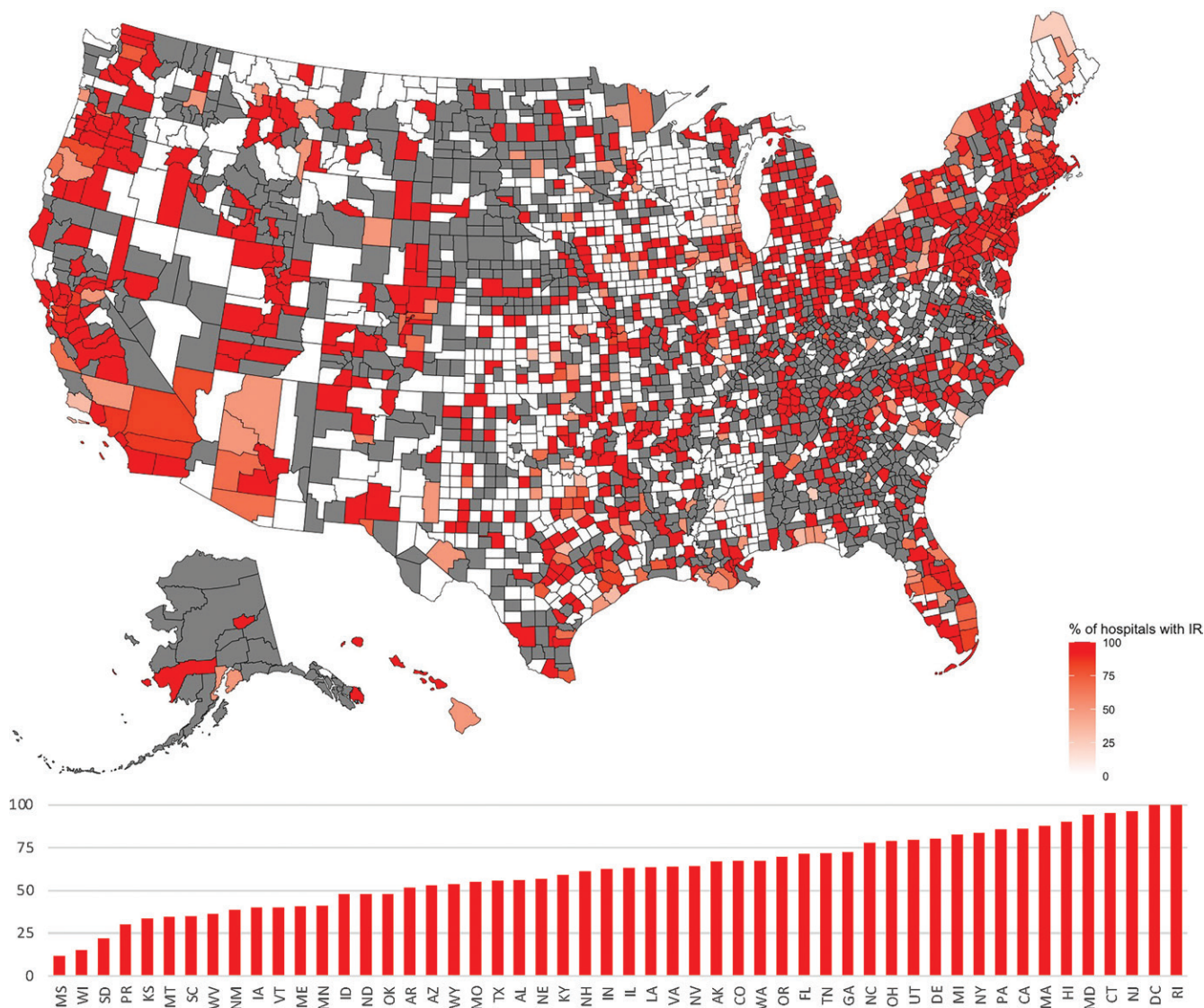
[†] As defined by the Office of Management and Budget, core-based statistical areas include a county or counties connected to an urban center through commuting ties. Metropolitan areas have urban centers of greater than 50 000 population, and micropolitan areas range between 10 000 and 50 000 population.

[‡] To meet the Center for Medicare and Medicaid Services' criteria for critical access hospital designation, hospitals must have fewer than 25 inpatient beds, have an annual average length of stay of 96 hours or less per acute inpatient hospitalization, and be located in a rural area or be recognized as necessary providers of health care services to residents in specific areas designated by states, among other requirements.

[§] As defined by the Center for Medicare and Medicaid Services, sole community hospitals are located in rural areas, are separated from other hospitals by 35 miles, and share less than 25% of their Medicare patients with other hospitals.

^{||} Hospitals that are members of the Council of Teaching Hospitals, have a medical school affiliation, or have one or more residency programs accredited by the Accreditation Council for Graduate Medical Education were classified as teaching hospitals.

[#] Except where indicated, data are means ± SDs.



Intensity map shows the percentage of hospitals reporting availability of interventional radiology (IR) facilities and services according to county and state. Counties shaded in gray did not have any hospitals present in the sample. Counties in white had at least one hospital in the sample, none of which reported owning IR facilities and services. Increasing opacity denotes a higher percentage of hospitals reporting the availability of IR facilities and services. The bar graph presents the percentage of hospitals that reported IR as available by state and/or territory.

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