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# Progress In Interoperability: Measuring US Hospitals' Engagement In Sharing Patient Data

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**ABSTRACT** Achieving an interoperable health care system remains a top US policy priority. Despite substantial efforts to encourage interoperability, the first set of national data in 2014 suggested that hospitals' engagement levels were low. With 2015 data now available, we examined the first national trends in engagement in four domains of interoperability: finding, sending, receiving, and integrating electronic patient information from outside providers. We found small gains, with 29.7 percent of hospitals engaging in all four domains in 2015 compared to 24.5 percent in 2014. The two domains with the most progress were sending (with an increase of 8.1 percentage points) and receiving (an increase of 8.4 percentage points) information, while there was no change in integrating systems. Hospitals' use for patient care of data from outside providers was low, with only 18.7 percent of hospitals reporting that they "often" used these data. Our results reveal that hospitals' progress toward interoperability is slow and that progress is focused on moving information between hospitals, not on ensuring usability of information in clinical decisions.

**S**ubstantial federal, state, and private-sector efforts target interoperable data exchange to provide clinician access to complete patient records at the point of care, regardless of where the information was generated.<sup>1–3</sup> A growing body of evidence reveals the quality and efficiency gains achieved from interoperability,<sup>4,5</sup> and it is also expected to be a key enabler of population-based alternative payment models, delivery reforms,<sup>6</sup> and improved performance measurement.<sup>7</sup> Although achieving "widespread interoperability" by 2018 has been declared a national objective, as of 2014 only about one-fifth of US hospitals were engaged in all four of its primary domains: electronically finding, sending, receiving, and integrating information into electronic health records (EHRs).<sup>8–10</sup>

These measures were available for the first time for 2014. It is critical to track progress in

interoperability engagement over time. Hospitals may be making rapid progress, as new technologies and policies make it easier for them to engage with interoperability domains. However, it is also possible that the one-fifth of hospitals engaging in the four primary interoperability domains included a unique set of early adopters and that remaining hospitals are moving slowly because of limited health information technology (IT) capabilities or weak incentives to share patient data.<sup>11</sup>

To track progress toward interoperability over time, we followed a cohort of hospitals from 2014 to 2015, first identifying those that became newly engaged in interoperability in 2015. We then identified the structural and IT characteristics associated with hospitals' becoming newly interoperable. Next, we examined downstream interoperability measures that capture whether information from outside providers is readily

available and used for clinical decisions. We used new data from the IT Supplement of the American Hospital Association (AHA) Annual Survey that became available only in 2015, to assess how often hospitals reported that their providers used electronic information from outside providers for the delivery of patient care, as well as the barriers to such use. Finally, we identified characteristics associated with hospitals' reporting both information availability and use.

To our knowledge, our study is the first to use longitudinal national data to examine trends in hospitals' engagement in interoperability and to examine the spectrum ranging from information availability to information use. Tracking interoperability over time is critical to informing a wide array of existing public- and private-sector efforts to ensure that EHRs across the United States will give providers access to complete clinical patient information. In particular, new policies such as the 21st Century Cures Act of 2016 seek to encourage data sharing in a variety of ways, and tracking hospitals' engagement with interoperability is critical to guiding the implementation of this legislation.

## Study Data And Methods

**DATA AND SAMPLE** We used data for 2014 and 2015 from the IT Supplement of the AHA Annual Survey to capture hospitals' engagement in interoperability, along with measures of other hospital characteristics.<sup>12</sup> The survey is sent annually to the CEO of every hospital in the United States, with a request that he or she either complete it or ask the most knowledgeable person in the organization to do so. To achieve a high response rate, all nonrespondents receive multiple mailings and follow-up phone calls. The most recent survey was fielded in the period December 2015–March 2016, and hospitals could complete the survey online or by mail. The survey was sent to 6,251 hospitals, and there were 3,538 responses (a 57 percent response rate).

To identify trends in interoperability over time and characteristics associated with hospitals that became new users of interoperable data, we created an analytic sample of the 2,636 hospitals that responded to both the 2014 and 2015 IT Supplements. We also created a cross-sectional sample of the 3,538 respondents to the 2015 IT Supplement, using newly available questions on the 2015 survey to identify how often hospitals had electronic access to and used data from outside sources in patient care.

We used data from the 2014 AHA Annual Survey to collect information on additional measures of hospital characteristics such as size, ownership, teaching status, location, system

membership, general medical surgical status, and participation in payment reform.

### MEASURES

► **DOMAINS:** We created four dichotomous measures to capture whether or not a hospital engaged in each of four domains of interoperability in 2014 and 2015. These domains, defined by the Office of the National Coordinator for Health Information Technology, capture the core elements of interoperability required for various clinical uses in which providers need to share information electronically.<sup>10</sup>

First, *finding information* involves the ability to query for patient data from outside provider organizations, and it is a critical capability for unplanned care transitions such as emergency department visits.<sup>13,14</sup> We identified hospitals that found data through the question, "Do providers at your hospital query electronically for patients' health information (e.g., medications, outside encounters) from sources outside your organization or hospital system?" Hospitals responding "yes" to this question were considered to be finding (querying) data.

*Sending and receiving information* enables providers to efficiently facilitate planned care transitions, such as referrals or following a hospital discharge to an outpatient setting or primary care provider. We identified hospitals that sent and received data through the question, "When a patient transitions to another care setting or organization outside your hospital system, how does your hospital routinely send and/or receive a summary of care record?" Respondents could choose from several options: "secure messaging using EHR (via direct or other secure protocol)," "provider portal," or "via health information exchange organization or other third party." Hospitals that responded "yes" to one or more options were considered to be electronically sending or receiving data.

*Integrating patient information* is the key capability that separates interoperability from health information exchange (HIE): Interoperability requires that no manual effort is necessary to integrate information into the EHR.<sup>8,15</sup> We identified hospitals that integrated information using the question, "Does your EHR integrate any type of clinical information received electronically (not eFax) from providers or sources outside your hospital system/organization without the need for manual entry? This could be done using software to convert scanned documents into indexed, discrete data that can be integrated into EHR." Hospitals that responded "yes, routinely" or "yes, but not routinely" were considered to be integrating information.

► **AVAILABILITY AND USE OF OUTSIDE INFORMATION:** We used two new questions on the 2015

IT Supplement to create a single dichotomous measure of whether providers in a hospital routinely had electronic access to clinical information from outside sources and used that information for patient care. The questions asked, “Do providers at your hospital routinely have necessary clinical information available electronically from outside providers or sources when treating a patient who was seen by another healthcare provider/setting?” and “How frequently do providers at your hospital use patient health information received electronically (not eFax) from outside providers or sources when treating a patient?” We created a third measure to identify hospitals that both had data available and used them: those who responded “yes” to the first question and “often” or “sometimes” to the second question.

A follow-up question for hospitals that answered “rarely” or “never” to the second question allowed us to assess the reasons for not using the data. We calculated the percentages of hospitals’ responses to each of five listed barriers to the use of outside information for patient care.

► **HOSPITAL CHARACTERISTICS:** We selected the hospital characteristics related to both health IT and organizational setting that we expected to be associated with engagement in interoperability, based on previous studies of interoperability and HIE.<sup>8,16</sup> Our IT characteristics included level of EHR adoption,<sup>17</sup> having one primary EHR vendor, having an EHR vendor that also served as the hospital’s HIE vendor, having a third-party HIE vendor, and participation in a regional health information organization.<sup>18</sup> Our organizational characteristics included size, teaching status, location, membership in a health care system, ownership, whether the hospital is a general medical surgical hospital or specialty hospital, and participation in the following reform models: a patient-centered medical home<sup>19</sup> or an accountable care organization (ACO).<sup>20</sup>

**ANALYTIC APPROACH** We first calculated the proportion of hospitals engaged in each of the four interoperability domains, as well as the proportion engaged in all four domains, in 2014 and 2015. All measures used weights generated by an inverse probability model that predicted survey response based on hospital size; teaching status; system membership; region; location; ownership; and critical access status (defined as being in a subset of rural hospitals identified by the Centers for Medicare and Medicaid Services [CMS] as those that provide care services in certain rural areas), according to information in the 2014 AHA Annual Survey. These weights accounted for nonresponse bias and created nationally representative estimates.

## Existing health IT infrastructure has primarily focused on how to move information between hospitals.

We then ran a series of logistic regression models to identify the relationships between hospital characteristics and becoming newly engaged in each of the four domains of interoperability between 2014 and 2015. While models included both IT characteristics and organizational characteristics, we focused on IT characteristics because we expected that these would be the primary determinants of progress toward interoperability. Hospitals that had the ability to send, receive, find, or integrate data in 2015 but not in 2014 were considered newly interoperable. All models used the weights described above and clustered standard errors by hospital referral region.

Next, we calculated the proportion of hospitals in 2015 that reported both routinely having access to electronic information from outside sources and routinely using such information in patient care. For the subset of hospitals that reported “rarely” or “never” using the information, we calculated the percentages that reported each barrier.

Finally, we ran a logistic regression model to examine the relationships between hospital characteristics and whether or not external information was available and used for clinical care. Our independent variables included engagement in the four interoperability domains and hospital IT and organizational characteristics.

**LIMITATIONS** Our findings should be interpreted with some key limitations in mind. First, we used self-reported survey data and were unable to verify the accuracy of responses. However, data from the IT Supplement to the AHA Annual Survey are widely used and have been validated against other sources.<sup>21</sup>

Second, because we used a two-year cohort sample that had slightly different characteristics from the full cross-sectional sample (in particular, greater IT sophistication), it is possible that our national estimates were biased. If they were,

this bias likely resulted in an overestimate of the levels of interoperability. Our measures of the domains of interoperability were dichotomous and did not capture granular information about the level and details of interoperable data sharing. Additionally, respondents could have interpreted in different ways what it meant to engage in a domain “routinely.”

Third, we focused our analyses on existing IT infrastructure and hospital characteristics, rather than market-related measures such as the availability of exchange partners. Previous work suggests that market forces play a role in a hospital’s decision to engage in interoperability,<sup>16,22</sup> and this is an important area for future research.

Fourth, because we sought to track progress in hospitals’ interoperability engagement at the national level, we were unable to capture many important granular characteristics of interoperability such as the mechanism by which data were shared, how clinicians received and used the data, and the specific instances in which shared data were useful in providing care.

Finally, while we used longitudinal data to identify key enablers of new engagement in interoperability, we had only two years of data and only cross-sectional data regarding the use of external information and barriers to that use. This limited our ability to assess causal relationships.

## Study Results

Seventy-one percent of the hospitals in our sample had at least a basic EHR system, and 77 percent used only one EHR vendor (for full characteristics of the hospitals, see online Appendix Exhibit A1).<sup>23</sup> Eighty-four percent had a third-party HIE vendor, 55 percent participated in a regional health information exchange organization, and 46 percent used their EHR vendor as their HIE vendor. Hospitals were predominantly small (52 percent) or medium-size (42 percent), located in an urban setting (65 percent), and privately owned nonprofits (55 percent). Nearly a quarter participated in an ACO (24 percent) or patient-centered medical home (23 percent), while 10 percent participated in both.

**INTEROPERABILITY PROGRESS FROM 2014 TO 2015** In 2015, 29.7 percent of hospitals engaged in all four domains of interoperability, an increase of 5.2 percentage points from 2014 (Exhibit 1). The level of hospital engagement increased in three of the four domains but remained almost unchanged in integration. A full breakdown of interoperability engagement by combinations of domains is presented in Appendix Exhibits A2 and A3.<sup>23</sup>

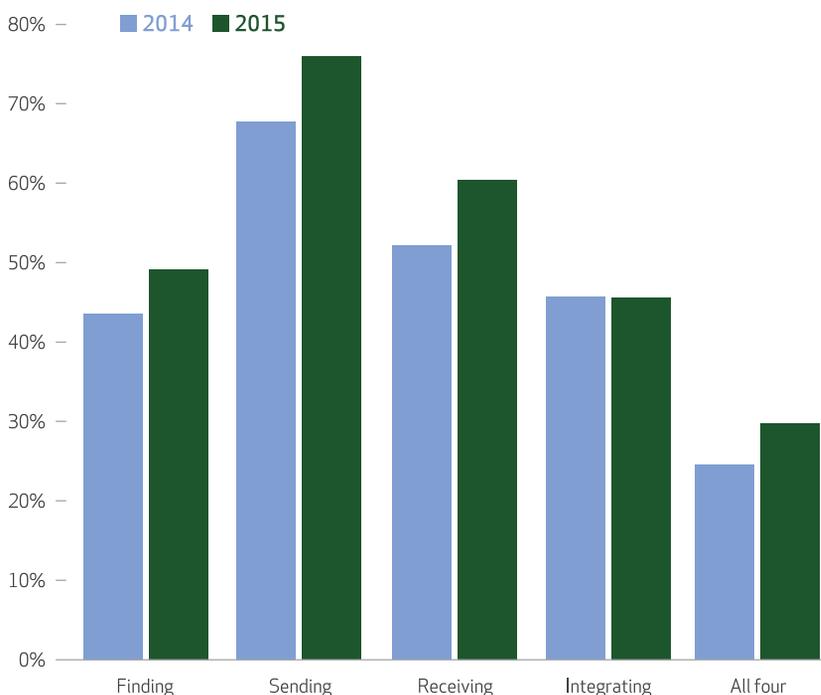
**ENGAGEMENT IN NEW INTEROPERABILITY DOMAINS** Compared to all other hospitals, those that newly engaged in finding data were more likely to have a basic or comprehensive EHR, have a third-party HIE vendor, and participate in a regional health information organization. (Exhibit 2). Hospitals that newly engaged in sending data were more likely to have a basic EHR, use a third-party HIE vendor, and participate in a regional health information organization.

Hospitals that newly engaged in receiving data were more likely to have a basic or comprehensive EHR, have a third-party HIE vendor, and participate in a regional health information organization. Finally, the small number of hospitals that newly engaged in integrating data were more likely to have a comprehensive EHR and use their EHR vendor as their HIE vendor. Organizational characteristics related to new engagement are reported in Appendix Exhibit A4.<sup>23</sup>

**AVAILABILITY AND USE OF OUTSIDE INFORMATION** In our cross-sectional sample of respon-

### EXHIBIT 1

Percentages of US hospitals with interoperability in four core domains, 2014 and 2015



**SOURCE** Authors’ analysis of data for 2014 and 2015 from the IT Supplement of the American Hospital Association Annual Survey. **NOTES** There were 2,636 hospitals that responded to the supplement in both years. Results were weighted to be nationally representative. The four domains are querying for data from outside sources (“finding,” in which the change from 2014 to 2015 was an increase of 5.6 percentage points), sending data to outside sources (“sending,” with an increase of 8.1 percentage points), accepting data pushed from outside sources (“receiving,” with an increase of 8.4 percentage points), and integrating outside data without manual intervention (“integrating,” with a decrease of 0.1 percentage point). There was an increase of 5.2 percentage points for all four domains.

## EXHIBIT 2

## Relationship between information technology (IT) infrastructure and new interoperability engagement by domain, 2014–15

IT capability	Domain of new engagement (odds ratios)			
	Finding	Sending	Receiving	Integrating
Basic EHR	1.65**	1.81**	1.80***	1.95
Comprehensive EHR	2.64***	1.17	2.13***	7.62****
Use of only one EHR vendor	0.98	1.52	1.16	0.94
Use of EHR vendor as HIE vendor	0.89	1.22	1.03	2.91****
Use of third-party HIE vendor	1.91**	3.49****	1.95***	0.51
Participation in regional health information organization	2.40****	2.90****	2.54****	1.54

**SOURCE** Authors' analysis of data for 2014 and 2015 from the IT Supplement of the American Hospital Association Annual Survey. **NOTES** The exhibit presents the odds of hospitals' engagement in the various domains compared to the reference category of having less than a basic electronic health record (EHR). There were 2,636 hospitals that responded to the supplement in both years. Results were weighted to be nationally representative. The model includes controls for hospital demographic characteristics that are not shown here but are listed in Appendix Exhibit A4 (see Note 23 in text). The domains are explained in the Notes to Exhibit 1. HIE is health information exchange. \*\* $p < 0.05$  \*\*\* $p < 0.01$  \*\*\*\* $p < 0.001$

dents from 2015, 43.0 percent of hospitals reported that they had outside clinical information available electronically when necessary (data not shown). In addition, 18.7 percent of hospitals reported that they used this clinical information for care delivery “often,” while 28.6 percent reported using it “sometimes,” 18.3 percent reported using it “rarely,” and 18.9 percent reported “never” using it (Exhibit 3). When we combined these two measures,

## EXHIBIT 3

## Hospitals' use of information from outside sources and barriers to its use, 2015

	Hospitals	
	Number	Percent
<b>FREQUENCY OF USE OF OUTSIDE DATA FOR PATIENT CARE</b>		
Often	637	18.7
Sometimes	972	28.6
Rarely	621	18.3
Never	642	18.9
Don't know	382	11.2
<b>BARRIERS TO USE<sup>a</sup></b>		
Information not available to view in EHR as part of clinicians' workflow	614	48.6
Difficult to integrate information in EHR	482	38.1
Information not always available when needed	412	32.6
Information not presented in a useful format <sup>b</sup>	302	23.9
Do not trust accuracy of information	107	8.5

**SOURCE** Authors' Analysis of data for 2014 and 2015 from the IT Supplement of the American Hospital Association Annual Survey. **NOTES** There were 3,397 respondents in 2015 for usage levels and 1,264 who indicated “rarely” or “never” to the previous question and responded to the questions about barriers to use. Results were weighted to be nationally representative. EHR is electronic health record. <sup>a</sup>Of the 1,263 hospitals responding “rarely” or “never.” <sup>b</sup>For example, too much information or redundant or unnecessary information.

we found that 35.3 percent of hospitals reported that information was available electronically and used it “often” or “sometimes” in the delivery of care (data not shown).

Among hospitals that reported that they “rarely” or “never” used information received electronically from outside sources, the most commonly cited barrier (48.6 percent) was the fact that clinicians could not view the information in the EHR as part of their workflow (Exhibit 3). Other barriers included difficulty in integrating information into the EHR, not having the information available when needed, and not having it presented in a useful manner.

Several characteristics were significantly associated with hospitals that reported both availability and use of outside information. The four interoperability domains were all independently associated with availability and use (Exhibit 4). Independent of these domains, hospitals with a comprehensive EHR; those that were part of a health care system, privately owned and for profit, and specialty hospitals; and those that participated in a patient-centered medical home (but not an ACO) were all more likely to have outside information available and use it in patient care.

## Discussion

There is widespread agreement among policy makers and researchers<sup>1,24</sup> that interoperability across EHR systems is needed to ensure that providers have access to all relevant clinical information about their patients so they can deliver high-quality care. We assessed the progress of interoperability among US hospitals and identified factors that may be driving new engagement. We found fairly slow progress from 2014 to 2015 as well as low levels of engagement in “last mile” interoperability functionality related to information integration and use. As policy makers continue to assess the state of interoperability in the United States and seek new mechanisms to encourage interoperable information sharing, tracking progress is critical.

Given that the majority of hospitals are not yet engaging in all four domains of interoperability, we sought to better understand the factors associated with hospitals' newly becoming interoperable. Our findings shed light on how different health IT capabilities may be supporting hospitals' engagement in different interoperability domains. While having a basic EHR system was associated with engagement in finding, sending, and receiving information, only having a comprehensive EHR system was associated with the integration of information without manual intervention. This result indicates that although having a core set of electronically captured pa-

tient data supports finding, sending, and receiving information, integrating is a far more difficult function, and only the more advanced EHR systems support this functionality. Similarly, having a third-party HIE vendor and participating in a regional health information organization were positively associated with finding, sending, and receiving, but not with integrating, information.

Taken together, these findings reveal that existing health IT infrastructure has primarily focused on how to move information between hospitals, not on ensuring that the information can be integrated—which is critical for information usability. A key enabler of integration appears to be using the same vendor for EHR and HIE, which avoids the complexity associated with integrating external information received from a third-party intermediary<sup>25</sup> and likely explains the growth of EHR-vendor HIE networks.<sup>26</sup>

While we were encouraged to find that each of the four domains of interoperability was positively associated with the availability and use of outside clinical information and that nearly half of hospitals were “often” or “sometimes” using this information in the delivery of patient care, there is still much room for progress. Issues with integrating information into existing EHR systems and clinical workflows were the most commonly cited barriers for hospitals that were not routinely using external information for patient care, which further underscores the need to shift the policy focus from transmitting information to information usability.<sup>15</sup> Our results show that participation in certain types of delivery reform, such as a patient-centered medical home, was positively associated with interoperability engagement. It is possible that pressure to make this shift may come from efforts to reform the delivery system. Information availability and use were significantly higher among hospitals participating in patient-centered medical homes, which come with strong incentives to use outside information for purposes such as population health management, tracking and following up on lab results, and the use of data analytics to identify high utilizers.<sup>27,28</sup>

## Policy Implications

To our knowledge, our study is the first to use national longitudinal data to assess interoperability progress and identify enablers of new engagement. It therefore has important implications for policy makers seeking to evaluate the degree to which the existing national policy efforts and investments in interoperability have encouraged hospitals’ engagement in data shar-

## EXHIBIT 4

### Hospital characteristics associated with the availability and use of information from outside sources, 2015

Characteristic	Odds ratio
<b>INTEROPERABILITY DOMAINS ENGAGED IN</b>	
Finding	6.77***
Sending	4.36***
Receiving	2.68***
Integrating	2.27***
<b>OTHER INFORMATION TECHNOLOGY CAPABILITY</b>	
Less than basic EHR	Ref
Basic EHR	1.26
Comprehensive EHR	1.61***
Participation in regional health information organization	0.83
<b>HOSPITAL SIZE (BEDS)</b>	
Small (fewer than 100)	Ref
Medium (100–500)	0.73***
Large (more than 500)	1.17
<b>TEACHING STATUS</b>	
Nonteaching	Ref
Teaching	0.99
<b>LOCATION</b>	
Rural	Ref
Urban	1.19
System membership	
Not part of a system	Ref
Part of a system	1.61***
<b>OWNERSHIP</b>	
Privately owned nonprofit	Ref
Local (nonfederal) government	0.94
Privately owned for profit	1.72***
Federal government	0.82
<b>TYPE</b>	
General medical surgical	Ref
Specialty	2.08***
<b>REFORM PARTICIPATION</b>	
No ACO or medical home participation	Ref
Participation in ACO only	0.99
Participation in medical home only	1.74***
Participation in both ACO and medical home	1.26

**SOURCE** Authors’ analysis of data for 2014 and 2015 from the IT Supplement of the American Hospital Association Annual Survey. **NOTES** The exhibit presents the odds of hospitals’ engagement in the various domains compared to the reference categories for each characteristic. There were 3,397 respondents in 2015. Results were weighted to be nationally representative. The domains are explained in the Notes to Exhibit 1. IT is information technology. EHR is electronic health record. ACO is accountable care organization. \*\*\*p < 0.01

ing. Our results support the notion that the four domains in the core definition of *interoperability* adopted by the Office of the National Coordinator for Health Information Technology contribute to the availability and use of outside clinical information, which is on the causal pathway to improved outcomes through interoperability.

Despite this, progress toward interoperability has been slow, with fewer than 30 percent of hospitals engaging in all four domains of interoperability in 2015 and with an increase of only

5 percentage points from 2014. This is substantially slower than the annual rate of national hospital EHR adoption over the past five years,<sup>29</sup> which suggests that existing policy efforts have stimulated interoperability engagement only modestly. It is therefore important that policy makers have shown continued interest in policies that promote broader interoperability engagement, including new measures of the interoperability performance of EHR vendors and penalties for impeding information exchange (called information blocking), in the recent 21st Century Cures Act.

Our results suggest that these efforts—particularly those focused on measurement—would be best targeted to the domain of information integration. A greater policy focus on integration, rather than on the sending and receiving of data, may help shift hospitals' focus to making data available at the point of care when it is clinically relevant. Hospitals should also assess important "last mile" issues, such as when and where outside data are being used. Low levels of use, which have been found in other studies,<sup>30</sup> should prompt hospitals to examine and address underlying barriers, such as low awareness of HIE capabilities or poor user interface design that makes it difficult to know when relevant information is available.

The results of these efforts will be particularly valuable if hospitals demand better interoperability as they become more engaged in reform efforts. In particular, policy efforts to expand the use of bundled payment should drive hospitals' demand for interoperability (specifically with long-term care providers) by providing a financial incentive for hospitals to be aware of the services delivered outside of their organizations.<sup>31</sup> Based on our results, policy makers may also want to assess how patient-centered medical home programs may be encouraging specific types of use of outside data, such as population health management, as this could provide lessons on how to effectively incentivize data sharing. In addition, as more providers participate in Medicare's Merit-Based Incentive Pay-

## A greater policy focus on information integration may help shift hospitals' focus to making data available at the point of care.

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ment System or in delivery system reform efforts such as Medicare's Advance Payment Models, hospitals are likely to be asked to become partners in these efforts that involve better management of patient populations and utilization—goals that are very difficult to achieve without robust interoperability.

### Conclusion

We used the most recent data from US hospitals to measure the current state of interoperability and assess progress over time. We found that in 2015, fewer than 30 percent of hospitals engaged in the four primary domains of interoperability, and this share was only a slight increase over that for 2014. Engagement in one domain—integrating outside information—was stagnant over time. This is a concern because integration is critical to data usability, and lack of integration was found to be a top barrier to the use of outside data in clinical care. Policy interventions, such as those in the recent 21st Century Cures Act, should therefore focus on ensuring that all hospitals are incentivized to pursue robust interoperability, with a particular focus on integration, to realize the cost savings and quality improvements that are expected to follow. ■

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The views expressed in this article represent the authors' views and do not necessarily reflect those of the Office of the National Coordinator for Health Information Technology.

## NOTES

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