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Research and Applications

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Characteristics of the healthcare information technology workforce in the HITECH era: underestimated in size, still growing, and adapting to advanced uses

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ABSTRACT

Objective: There is little readily available data about the size and characteristics of the healthcare information technology workforce. We sought to update a previous description of the size, growth, and characteristics of this workforce based on the Healthcare Information Management Systems Society (HIMSS) Analytics® Database, a resource that includes hospital size, number of beds, amount of staffing, and an eight-stage model of electronic health record adoption (Electronic Medical Record Adoption Model, EMRAM^{SM}).

Materials and Methods: We updated an analysis done using a 2007 snapshot of the HIMSS Analytics Database with a comparable snapshot from 2014 in order to estimate the size of the current workforce and project future needs. For the 2014 data, we applied the same weighted average analysis used in 2007 to obtain a ratio of information technology (IT) hospital full-time equivalent (FTE) to staffed beds, extrapolate the results to all US hospitals, and project the workforce needs as hospitals achieve higher EMRAM stages.

Results: Our estimated size of the healthcare information technology workforce in the US in 2014 was 161 160, which was 8.0% larger than the estimate based on the 2007 data. Based on the new data, we project a potential need for an additional 19 852 and 153 114 FTE, if all hospitals were to achieve EMRAM Stages 6 and 7, respectively. The distribution of FTE across job function category varies by EMRAM stage.

Discussion and Conclusions: Although these data are limited, especially for EMRAM Stage 7, there is likely need for substantial workforce growth as hospitals increase their adoption of advanced healthcare information technology. Further research with data better focused on workforce characteristics will provide a better picture of staffing requirements.

Key words: health information technology, workforce, health information technology for economic and clinical health act, electronic health records

INTRODUCTION

Since passage of the Health Information Technology for Economic and Clinical Health (HITECH) Act in 2009 and its subsequent implementation in 2010,[1] the adoption of the electronic health record (EHR) has grown substantially in the USA, especially in hospitals. In 2008, less than 10% of US hospitals had any EHR, whereas by 2014, 96% had adopted one.[2] There has also been substantial growth of EHR adoption by office-based physicians, with 83% having any EHR.[3] Other outpatient settings have also seen comparable growth in adoption spurred by the HITECH Act.[4]

The main goal of the HITECH Act was to provide incentives for increased adoption of EHRs by eligible professionals and hospitals.[5]

Table 1. Stages of the HIMSS Analytics Electronic Medical Record Adoption Model (EMRAM) with hospital distributions in the US from 2007 and 2014[7]

Stage	Capabilities	2007 (%)	2014 (%)
7	Complete EMR; CCD transactions to share data; data warehousing; data continuity with ED, ambulatory, OP	0.0	3.7
6	Physician documentation (structured templates), full CDSS (variance & compliance), and full R-PACS	0.8	22.2
5	Closed loop medication administration	1.4	30.8
4	CPOE, CDS (clinical protocols)	2.2	13.6
3	Nursing/clinical documentation (flow sheets), CDSS (error checking), and PACS available outside radiology	18.0	19.7
2	CDR, controlled medical vocabulary, CDSS, may have document imaging; HIE capable	37.2	4.3
1	Ancillaries—lab, radiology, pharmacy—all installed	14.0	2.2
0	All three ancillaries not installed	19.3	3.5

EMR: electronic medical record; CCD: continuity of care document; ED: emergency department; OP: outpatient; CDSS: clinical decision support system; R-PACS: radiology picture archiving and communication system; CPOE: computerized physician order entry; CDR: clinical data repository; HIE: health information exchange.

In order to facilitate adoption of EHRs, the HITECH Act also included programs for regional extension centers, research, and workforce development. The rationale for workforce development was that a larger and more skilled workforce would be required for successful EHR adoption.[6] This resulted in an investment of $118 million by the Office of the National Coordinator for Health IT (ONC) for workforce development to help meet the demands of the HITECH Act.

Historically, there has been a paucity of research that quantifies and characterizes the healthcare information technology workforce. This gap is detrimental to the field because information about the healthcare workforce is needed to inform national policy that supports training, the content of training programs, and the hiring and planning process of healthcare organizations. Ultimately policy that promotes EHRs and their use to improve the quality and efficiency of healthcare cannot succeed without a sufficiently large, well-trained workforce.

The only national, hospital-reported data available about the size of the US healthcare information technology workforce has been the Healthcare Information Management Systems Society (HIMSS; Chicago, IL) Analytics Database, which tracks hospital size, stage of EHR adoption, and amount of staffing, both overall and in categories. The component of the HIMSS Analytics Database that tracks stage of EHR adoption is the Electronic Medical Record Adoption Model (EMRAM), which designates eight stages of adoption from 0 through 7 (see Table 1).[7]

In 2008, just prior to the HITECH Act, Hersh and Wright[8] attempted to assess the size and characteristics of the portion of this workforce employed in hospitals and health systems based on data from the 2007 HIMSS Analytics Database. They also projected the growth required to achieve EHR adoption consistent with levels associated with functionality demonstrated to improve patient outcomes, namely the use of clinical decision support and computerized provider order entry. A systematic review published at that time reported that this level of functionality was associated with better clinical outcomes.[9]

This analysis of the HIMSS Analytics Database 2007 data reported the ratio of total hospital full-time equivalent (FTE) to information technology (IT) FTE was 60.7 and that most hospitals were at lower stages (1–3) of adoption.[8] They found that healthcare information technology staffing levels increased through Stages 1–4 and then tapered off at Stages 5–6. Although, at that time, the number of hospitals at Stages 5 and 6 was very small, so these estimates at the higher stages were not thought to be reliable. This previous analysis estimated that the healthcare information technology workforce in 2007 was 108 390 FTE, and projected it would need to increase by 40 784 FTE to 149 174 if all hospitals were to achieve Stage 4, the stage associated with improved clinical outcomes based on the systematic review findings.[9]

Between 2007 and 2014, the percentage of hospitals at higher stages of adoption increased, as shown in Table 1.[7] Also, since 2007, three additional systematic reviews using similar methodology have reiterated that higher levels of adoption are associated with mostly positive clinical outcomes.[10–12] The increased adoption of EHRs and investment in workforce development raise questions about the healthcare information technology workforce, such as whether the predictions based on 2007 data that higher EHR adoption would require a larger workforce would be realized and whether gaps remain between the 2014 workforce size and what might be required if all hospitals move toward paperless medical records, that is, EMRAM Stages 6 and 7.

The goal of this study was to repeat the analysis of 2007 data with 2014 data covering activity well into the HITECH era. (After 2014, HIMSS Analytics changed the database to stop collecting job category data.) During this time, there has been not only substantial adoption of EHRs but also achievement of higher stages of the EMRAM model. We aimed to estimate the 2014 healthcare information technology staffing levels, evaluate how well the previous analysis predicted 2014 staffing, and project what staffing levels might be needed in the future based on likely increased adoption of EHRs. We also repeated analysis of the distribution of staff roles within healthcare information technology to explore differences at various EMRAM stages.

METHODS

An extract of the HIMSS Analytics Database for US hospitals through the end of 2014 was obtained ($n = 5478$). Data extracted and analyzed included EMRAM stage, facility name and identifier, parent entity name and identifier, location, number of beds, number of staffed beds, number of total IT FTE, and number of IT FTE for management, project management, programming, operations, network administration, help desk, PC support, security, and EMR support.

Hospitals that did not report any information about IT staffing ($n = 3512$) or reported zero FTE IT staff ($n = 186$) were not included in the analysis. To determine whether the excluded hospitals were different from those that reported FTE staffing, we compared rates of no reported, 0 FTE reported, and non-zero FTE reported at each stage. We also consolidated data where multiple hospitals within a group of affiliated hospitals reported the exact same staffing data,

reducing these to a single entry. The resulting data set included facilities that reported total IT staff ($n = 1660$). Of these, most, but not all, reported the distribution of that staff across IT functions ($n = 1400$, 83%).

To estimate values for the entire national workforce, we extrapolated the data from completed surveys to the national number of staffed beds according to the American Hospital Directory ($n = 764\ 656$)[13] for the period covered by the HIMSS Analytics Database extraction. We also calculated distribution of staff across roles at different EMRAM stages. All analysis was carried out using Microsoft Excel Professional 2013 with the Data Analysis tools add-in (Microsoft Corp., Redmond, WA, USA).

We calculated IT FTE per staffed bed both overall and segmented by EMRAM stage repeating the method used to analyze the 2007 data. That is, we took the aggregated FTE staffing ratio obtained from the reported data for hospitals at each stage and multiplied it by the number of hospital beds at that stage across the USA to get weighted estimates of the FTE needed both overall and by stage. Our results are based on analysis of data reported by 1660 hospitals, representing 31% of hospitals in the database. (The 2007 data analysis included 1318 hospitals, representing 27% of hospitals in the database). The 1660 included hospitals had 245 599 staffed beds, representing about one-third of the 764 656 staffed beds in the US in 2014.

RESULTS

Characteristics of included hospitals

As seen in Table 2, distribution of not reporting FTE, 0 reported FTE, and non-zero reported FTE varied moderately by EMRAM score, with the highest level of non-reporting at the extremes, 0 and 7. There is a similar, though less pronounced, pattern related to size of hospital (defined as the number of beds), as shown in Table 3. The data in these tables show a statistically significant (both $P < .05$) difference in a χ^2 test, indicating some difference between the distribution of hospitals that report FTE by EMRAM stage and hospital size versus all hospitals.

IT staffing rate by EMRAM stage

The IT staffing ratios, as well as the number of hospitals and beds for each EMRAM stage for both 2007 and 2014 are reported in Table 4. The 2007 data are from the prior Hersh and Wright study and show estimated FTE per staffed bed at each of the EMRAM stages for which data were available at that time. In both sets of data, the FTE per staffed bed levels off at Stages 4–6. The 2014 data show an increase in staffing levels for EMRAM Stage 7 (with data not available in 2007 for any hospital at this stage).

As with the 2007 data, the average IT staffing ratio based on the 2014 data varied by EMRAM stage. Table 4 shows that the overall IT staffing ratio per bed increased from 0.142 in 2007 to 0.211 in 2014 across all stages. These data are also presented in Figure 1. As would be expected from increasing rates of IT hiring, the total facility staff to IT staff ratio for hospitals declined in the same time period from 60.7 to 33.3. This also indicates that the increase in IT hiring was not just an artifact of an overall increase in hiring in hospitals.

National workforce estimates

Figure 1 also shows the estimated number of 2014 healthcare IT staff extrapolated to the entire USA. The bar graph portion of the figure shows the number of healthcare IT staff estimated to be employed by hospitals at different EMRAM stages. It can be seen that the bulk of the workforce is employed in Stage 6 settings, due to the large number of hospitals that have reached that stage along with the increase FTE/Bed ratio. These data estimate that the healthcare IT workforce totaled 161 160 in 2014, which suggests that growth exceeded the projection based on the 2007 data. (The projection based on 2007 was that 149 174 would be needed, representing an increase of 11 986, or about 8.0%.)

Table 2. Distribution of hospitals not reporting FTE, reporting 0 FTE, and reporting values for FTE for different EMRAM stages

EMRAM Stage	Not reporting		Reporting zero		Reporting values		Total
	Count	Percent	Count	Percent	Count	Percent	Count
0	173	83	8	4	26	13	207
1	80	74	3	3	25	23	108
2	206	74	8	3	63	23	277
3	767	68	135	12	230	20	1132
4	508	67	4	1	247	33	759
5	643	58	16	1	454	41	1113
6	974	62	10	1	585	37	1569
7	161	83	2	1	30	16	193
Total	**3512**	**66**	**186**	**3**	**1660**	**31**	**5358**

Table 3. Distribution of hospitals not reporting FTE, reporting 0 FTE, and reporting values for FTE for different bed size groups

Hospitals by bed size	Not reporting		Reporting zero		Reporting values		Total
	Count	Percent	Count	Percent	Count	Percent	Count
0–25	448	61	31	4	257	35	736
26–50	856	61	110	8	441	31	1407
51–100	680	73	28	3	218	24	926
101–200	692	70	7	1	295	30	994
201–300	377	65	3	1	196	34	576
301–500	316	65	4	1	166	34	486
501 or More	143	61	3	1	87	37	233
Grand Total	**3512**	**66**	**186**	**3**	**1660**	**31**	**5358**

Table 4. Hospitals, beds, and staffing ratios by Electronic Medical Record Adoption Model (EMRAM) Stage for 2014 and 2007 data

EMRAM Stage	2014 Data			2007 Data		
	Hospitals	Beds	FTE/Bed	Hospitals	Beds	FTE/Bed
0	26	579	0.064	60	9069	0.082
1	25	996	0.058	132	30 391	0.096
2	63	4834	0.097	437	120 315	0.122
3	230	25 670	0.135	538	157 383	0.151
4	247	23 014	0.211	81	29 439	0.210
5	454	53 981	0.180	39	15 256	0.167
6	585	126 103	0.229	31	10 987	0.196
7	30	10 422	0.411	0	0	NA
Total	1660	245 599	0.211	1318	363 771	0.142

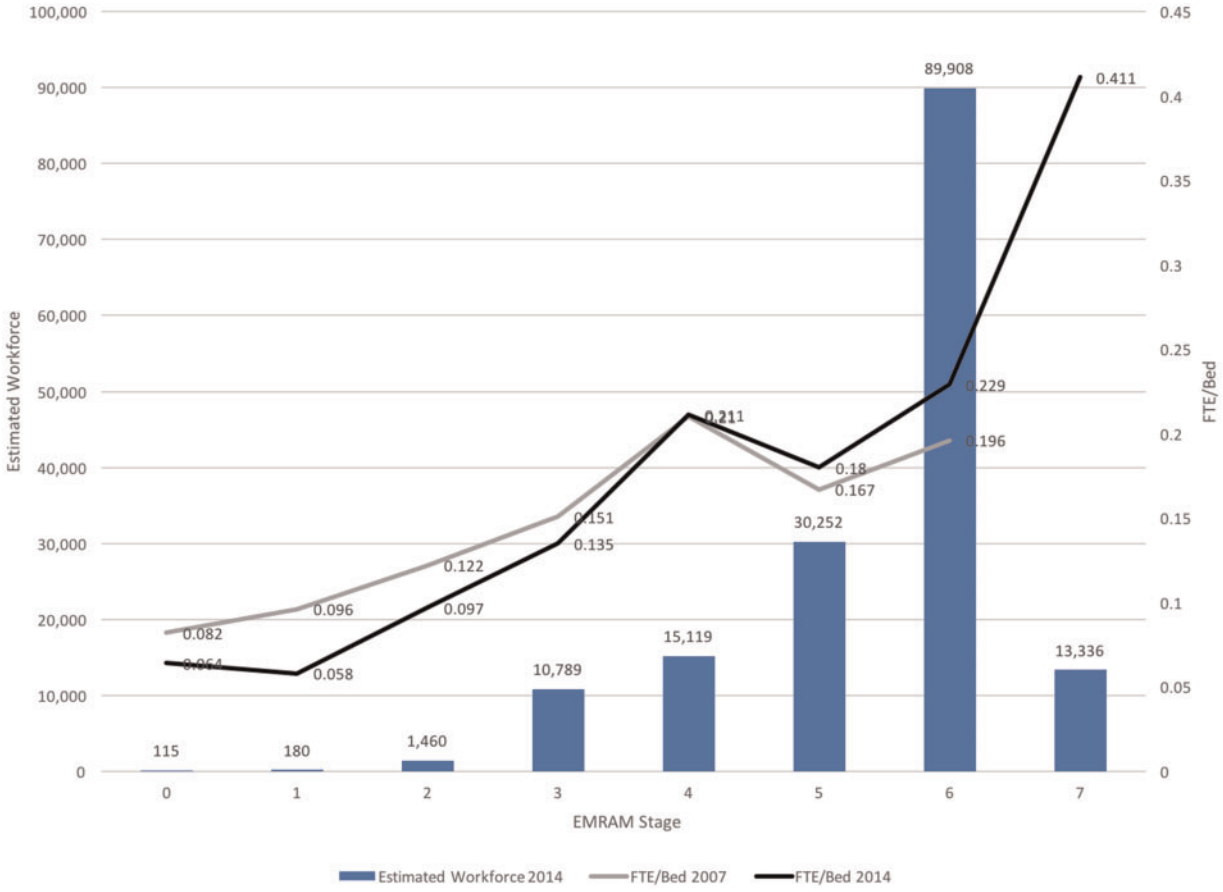

Figure 1. Healthcare IT FTE per staffed bed for 2007 and 2014 and estimated workforce for 2014 at EMRAM Stages 0–7.

From this data, we can also calculate the additional workforce needed if all hospitals currently below Stage 6 were to achieve Stage 6, and then if all hospitals were to achieve Stage 7, given the assumption that those hospitals would have similar staffing requirements as the hospitals currently at those stages. If all hospitals were to achieve Stage 6, with FTE/Bed staying constant, a total of 167 676 FTE would be required and, when combined with the existing 13 336 from hospitals at Stage 7, the total estimated workforce would be 181 012. This represents an increase of 19 852 (11.0%) over the workforce estimates at the current EMRAM stages.

If all hospitals were to achieve Stage 7, with all of them maintaining the Stage 7 FTE/Bed ratio, the total estimated workforce would increase to 314 274, representing an increase of 153 114 (48.8%) over the current workforce estimates. We note that this estimate is derived from the relatively small number of beds in hospitals that have achieved Stage 7, and we have less confidence in its extrapolation to the entire US healthcare system.

A final analysis assessed distribution of staff across functions. Only about half (756 out of 1660) hospitals reported distributions of staff (the rest just reported total FTE). Figure 2 shows the overall distribution of staffing functions reported for 2014 compared with 2007, indicating no substantial change by category. Further analysis of the 2014 data, however, reveals substantial differences across EMRAM stages. As seen in Table 5, in the pre-adoption stage (EMRAM Stage 0), facilities typically have much more IT management, few programmers or help desk staff, and little project management. As facilities begin to adopt IT in these early stages (EMRAM Stage 1), operations staff rapidly increase. In early stages of EHR adoption (EMRAM Stages 2–3), more programmers are added, management becomes a smaller portion of IT staff, and PC support, network administration, and help desk staff are added. In higher EMRAM stages, other staff are brought on board to facilitate adoption, but these personnel do not fit into traditional healthcare information technology job categories, as evidenced by the large number of staff reported under "Other." This category might also include those who work in newer job functions, such as data analytics or population health.

DISCUSSION

Our analysis of data from 2014 supports the conclusion that healthcare information technology staffing has increased substantially in the HITECH era, and increased beyond projections based on the analysis of 2007 HIMSS data. This original analysis based projections for workforce growth on increasing adoption to EMRAM Stage 4 because little data was available at that time to determine the impact of higher EMRAM stages. Since 2007, not only has adoption increased substantially, but it has also been at higher EMRAM stages, which the current analysis found to be associated with even higher levels of staffing. Although it is not clear how many hospitals will need to (or be able to) achieve EMRAM Stages 6 or 7, the healthcare information technology workforce will likely continue to grow.

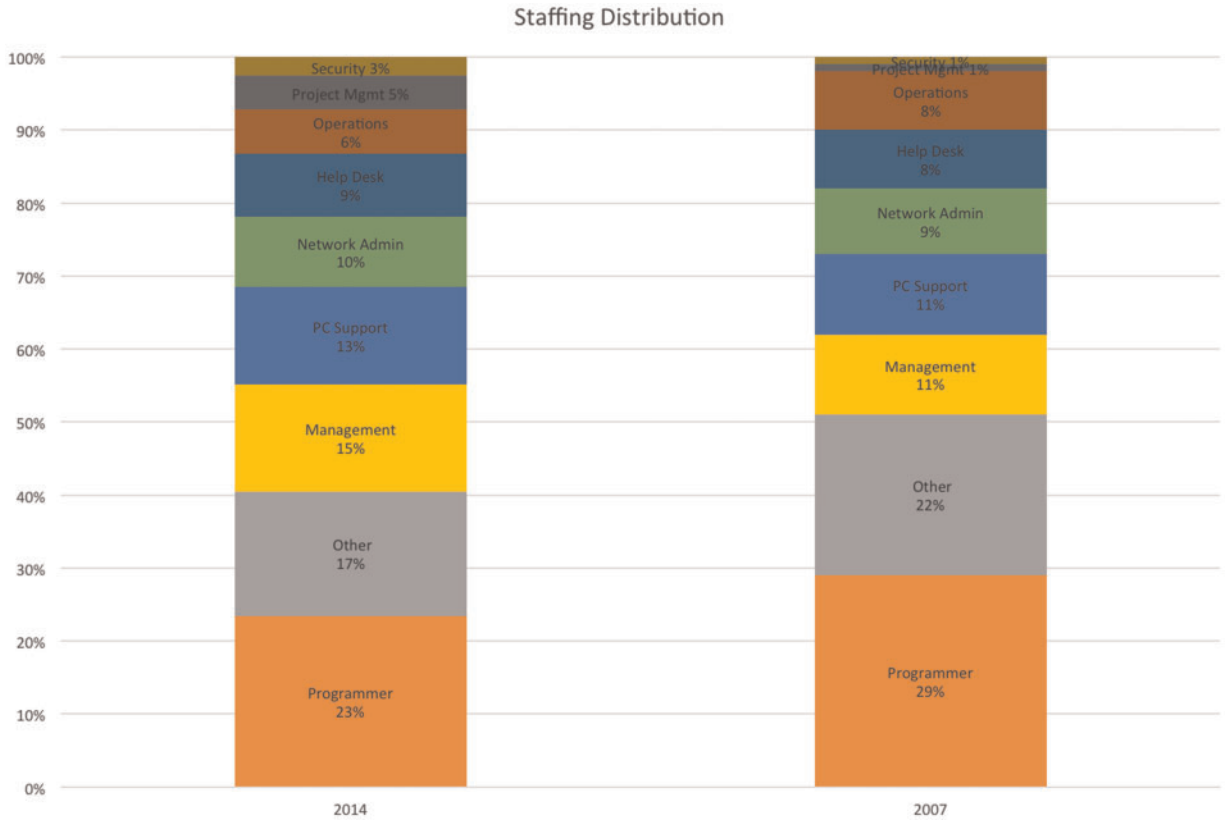

Figure 2. IT staffing distribution across functions from 2007 and 2014 data.

Table 5. Distribution of IT staffing by job category across EMRAM stages, 2014 data

EMRAM Stage	Programmers (%)	Other (%)	Management (%)	PC support (%)	Network Administration (%)	Help desk (%)	Operations (%)	Project management (%)	Security (%)
0	3.3	3.3	70.0	10.0	6.7	3.3	0.0	0.0	3.3
1	2.3	2.3	47.7	13.6	6.8	15.9	11.4	0.0	0.0
2	13.1	4.8	32.2	16.7	9.7	11.6	3.9	5.8	2.3
3	23.6	13.8	15.1	14.0	9.1	10.1	6.6	5.6	2.0
4	21.6	16.8	18.1	11.3	9.8	8.6	7.2	4.0	2.5
5	25.7	17.2	14.6	12.2	10.2	8.4	5.9	3.5	2.2
6	24.0	15.8	14.1	13.9	9.5	8.7	6.1	5.0	2.8
7	18.7	27.9	11.8	13.4	9.3	7.8	4.2	4.3	2.7

One concern about these increased staffing requirements is the potential increase in overall healthcare employment. If these estimates are correct, advancing all hospitals in the US to EMRAM Stages 6 or 7 will add 19 852 or 153 114 additional staff, respectively to the current 161 160 staff already working in healthcare information technology. While these numbers may seem large, they are a small fraction of the 12.0 million people estimated to be employed in healthcare in the United States.[14] Looked at another way, the total facility staff to IT staff ratio of 33.3 indicates that a larger healthcare information technology workforce only comprises about 3.3% of the total hospital workforce.

This analysis has several limitations. Most notably, the HIMSS Analytics Database is incomplete, self-reported data on a limited number of variables. About one-third of the 5479 hospitals surveyed reported FTE staffing levels, and around one-sixth reported distribution of staffing roles, with the distribution of those reporting differing from the general distribution, as shown by χ^2 analysis. The HIMSS Analytics Database is also hospital-oriented, and although increasing numbers of hospitals have outpatient facilities that employ physicians who use the hospital EHR, there are multiple other settings where IT is used, including purely ambulatory settings, skilled nursing facilities, and others which are not included. Additionally, there are also other places where healthcare information technology professionals are employed, such as software vendors, contractors, insurance companies, and the growing number of services offered to consumers. The increased utilization of "Other" staff at higher adoption levels may reflect non-traditional IT roles, but could also reflect increased utilization of informaticians and data analysts who do not readily fit into the categories provided in the HIMSS Analytics Database. A key limitation is that respondents to the FTE staffing levels questions of the HIMSS Analytics Database may not be representative of all US hospitals. This analysis is limited

by the available data, and they could be more precise if more hospitals provided data and more complex models could be built if the dataset contained additional information about the hospitals.

While these are serious limitations that should be considered when interpreting our results, the HIMSS Analytics Database provides the only dataset containing these metrics available at this time. The analysis of the HIMSS Analytics Database 2007 data reported the ratio of total hospital FTE to IT FTE was 60.7, which was consistent with data from another study of IT in integrated care delivery organizations from the same time.[15] Two subsequent studies, one from Australia[16] and one from Canada[17] also reported total FTE to IT FTE ratios in this range. This agreement across these estimates supports the utility of the HIMSS Analytics Database on workforce FTE despite its limitations.

There are other data that are consistent with growth in the size of the workforce during the HITECH era. A 2012 report from the ONC noted that the number of online healthcare information technology job postings per month increased much more (199%) relative to healthcare jobs (57%) and all jobs (52%) between 2009 and 2012.[18] The report also estimated that over 50 000 new jobs were created during that time period. A follow-up analysis found that between 2007 and 2011, 226 356 jobs were posted.[19]

Going forward, many stakeholders will need accurate estimates of the size, growth, and skill sets of the healthcare information technology workforce. Healthcare organizations will need to estimate the resources required to advance the size and skills of their workforce, especially as healthcare transitions to value-based care and enters the era of Big Data.[20] Educational institutions that train the workforce will similarly need such data to tailor the size and competencies taught of both their initial and continuing education programs. Likewise, policy makers will need to take into account workforce issues as they develop changes in reimbursement, care models, and other aspects of healthcare reform. The cost-benefit of this workforce of increased size will need to be assessed.

Ultimately, data with much more detail and more comprehensive in coverage will be required. If such data are desired, the myriad of organizations interested in health financing, technology usage, and workforce development will need to come together to determine the key research questions and the data required to answer them. Any future workforce data from organizations such as HIMSS Analytics or others must provide more exhaustive and complete data to better elucidate and understand these workforce needs. The data should also distinguish such factors as where in the organization they predominantly work (eg, inpatient vs. outpatient or both). In addition to obtaining details about the current and projected workforce, other questions to be answered will include the skills and training required, especially given changes in the healthcare system and its financing, and how competition for such talent outside of healthcare will potentially provide incentive to work in other industries. Such analyses should also include job satisfaction, remuneration, and opportunities for advancement.

Another possible source of better data, at least for the United States, would be the incorporation of the healthcare information technology workforce in federal labor statistics, that is, in the Standard Occupational Classification (SOC) of the Bureau of Labor Statistics. A coalition of organizations, including the American Medical Informatics Association, advocated updating the SOC for its 2018 revision with codes for the occupations of the health informatics, health information technology, and health information management.[21] Although such codes appeared in the interim draft version of the SOC 2018 update, they were ultimately not added to the final revision.[22] While new SOC codes would have facilitated collection of more precise information about the workforce, a much more granular classification would still be needed to understand the exact job activities and required training of different personnel working in healthcare information technology. On the international level, there is also an International Standard Classification of Occupations.[23]

CONCLUSION

Our analysis estimates that even though the healthcare information technology workforce is a small part of the overall hospital and health system workforce, it will likely continue to grow as the adoption and use of EHRs evolves. This has implications for the requirements for training the workforce, with additional workforce development being a necessity. It also raises questions about the cost and value of the workforce, and how it might be optimized. For these reasons, additional research that includes more detail about the workforce is required.

CONTRIBUTORS

W.H. conceptualized the work and oversaw the obtaining of data, its analysis, and conclusions drawn from it. K.W.B. carried out the detailed processing and analysis of the data and presented results to the two other authors for discussion and interpretation. A.M.T. provided methodological expertise in carrying out the data analysis. W.H. was the main author of the manuscript and the other two authors provided feedback and editing.

Conflict of interest statement. None declared.

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