

Nationwide Health Information Network (NHIN) Workforce Study

Final Report

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Executive Summary

For the past several years, the nation has been working to improve health care through the widespread implementation of electronic health records. One clear prerequisite for accomplishing this goal is the availability of a trained workforce to implement the developing Nationwide Health Information Network (NHIN). While it is generally acknowledged that the nation does not have a sufficient number of trained specialists for this purpose, no prior studies have produced any quantitative estimates of the workforce requirements. Accordingly, the current research was designed to further our understanding of NHIN workforce issues by collecting, assessing, and analyzing existing knowledge and data in this domain with the objective of producing an initial estimate of the number of people needed.

This study gathered information through a series of four focus groups, five site visits, and direct communications with health information technology (HIT) vendors. The anticipated NHIN work was divided into three separate categories of activities for the purpose of assessing workforce: 1) electronic health records (EHRs) in physician offices; 2) EHRs in hospitals and other health care institutions; and 3) the health information infrastructure (HII) required in communities to link the various sources of records so that each patient's complete electronic record could be available.

Assuming a 5-year time frame for NHIN implementation, results indicated that 7,600 (+/- 3,700) specialists are needed for installation of EHRs for the approximately 400,000 practicing physicians who do not have them already. For the hospitals needing EHRs (about 4,000), approximately 28,600 specialists are needed. Finally, about 420 people are needed to build the HII systems in communities to interconnect all these other systems. These data represent the first ever quantitative estimates of the workforce needed to implement the NHIN.

These estimates should be considered preliminary and imprecise as they are based on a very small number of reports: eight for physician EHRs, four for hospitals (no data were available for other types of health care institutions), and two for communities. Furthermore, since all reported data was retrospective, the various estimates are based on information collected inconsistently at different times and under varying circumstances. Insufficient information was available to be able to characterize meaningfully the different types of personnel needed, although at least 15 different job titles were identified and defined. There was also inadequate information to allow workforce estimates for different architectures for the three major activities, despite general agreement from the expert panels that differences in architecture may have a significant impact on the personnel needs. Similarly, there was not enough data to assess or categorize the impact of size of practice or institution on workforce. However, there were some indications that the personnel requirements per physician are higher for smaller physician offices (three physicians or less). Also, the workforce data relates only to installation of systems; ongoing support and maintenance were specifically excluded. Finally, it is notable that there is no available data about the current number of specialists working in the three areas, so it is not clear whether these estimates indicate a shortage of personnel.

Further research is needed to confirm and refine these estimates, as well as overcome the limitations of these results. Nevertheless, these first-ever quantitative estimates of the workforce

needed for NHIN implementation will inform such additional studies, lead to an improved understanding of this important domain, and ultimately help ensure that adequate numbers of personnel are available for this critical work.

I. Introduction

In 1991, the Institute of Medicine (IOM) called the electronic health record (EHR) “an essential technology for patient care.”ⁱ Although this early report spurred considerable action and some progress in the 1990s, it was the subsequent report, *To Err Is Human*,ⁱⁱ from the IOM in 1999 that really focused the attention of the nation on the pervasive problems of safety and quality in our health care system, largely traceable to the limited application of modern information management. That report estimated that medical errors result in between 44,000 and 98,000 preventable deaths each year in hospitals alone. A more recent study showed that only fifty-five percent of U.S. adults with common chronic diseases were receiving recommended care.ⁱⁱⁱ

This was further elucidated and emphasized in subsequent reports from the IOM^{iv,v} and other national expert panels including the President’s Information Technology Advisory Committee^{vi,vii} and the Computer Science and Telecommunications Board of the National Research Council.^{viii} In 2001, the National Committee on Vital and Health Statistics (NCVHS), a statutory advisory committee to the U.S. Department of Health and Human Services (DHHS), explicitly recommended development of a National Health Information Infrastructure (NHII).^{ix} By then, it had been recognized that EHR systems alone were not enough - the systems would need to interconnect and communicate to ensure that patient information dispersed among the various places where care had been given were assembled into a complete record immediately available at any point-of-care. It was also clear that modern information management was an essential prerequisite to improving all aspects of health care, leading the IOM Committee on Patient Safety to conclude in 2003 that “establishing this information technology infrastructure [NHII] should be the highest priority for all health care stakeholders.”^x

In response to the 2001 NCVHS report, the DHHS began to focus on this issue by adopting health information standards for use by the Federal government and licensing the controlled vocabulary SNOMED for use at no charge by anyone in the United States. In 2003, the first NHII conference developed a consensus national action agenda.^{xi} The following year, the President created the Office of the National Coordinator for Health Information Technology (ONC) in the DHHS and a Strategic Framework was announced espousing the goals of informing clinicians, interconnecting clinicians, personalizing care, and improving population health.^{xii} Besides improving safety and quality, it has been estimated that the annual national savings from NHII (now also known as the NHIN or the Nationwide Health Information Network) could exceed \$130 billion, about 8 percent of current health care spending.^{xiii}

A key implementation strategy emanating from the IOM, the 2003 NHII consensus national agenda development meeting,¹¹ and the DHHS Framework for Strategic Action¹² is the concept of building local or regional health information infrastructures (HIIs) to implement the organizational, financial, legal, and technical capabilities needed to interconnect all sources of health information.^{xiv} Since health care itself is a local activity and the difficult sociopolitical issues related to sharing health information are best addressed at the local level, this approach

seemed both pragmatic and feasible. This view has been reinforced by the early successes of a few community HII projects, such as Spokane, Washington, and Indianapolis, Indiana.

While widespread application of HIT is not a panacea for all the complex and difficult problems of our health care system, it is a critical prerequisite to addressing many, if not most, of the key issues such as higher quality care, increased access, more effective chronic care delivery, and the ability to empower active consumer participation in their own health care. The ability of HIT to both measure and directly impact the everyday processes of health care will enable ongoing design, development, implementation, and evaluation of policy initiatives to improve the quality and efficiency of care.

Recognizing the potential value of HIT, efforts are underway in communities throughout the nation to promote adoption and use of EHRs, as well as the connectivity required to integrate the information to provide complete medical records for each person whenever and wherever needed. The experience of communities that have been pioneers in the development and implementation of HIIs demonstrates that the application of health information technology to improve health care can be both feasible and practical. However, such efforts are also complex, difficult, and risky. At least five major categories of issues must be addressed: 1) obtaining the buy-in of the community; 2) developing appropriate governance mechanisms to ensure fair and equitable sharing of power; 3) dealing with each stakeholder's concerns about ownership of data; 4) developing appropriate and sustainable financing arrangements that match costs with benefits; and 5) acquiring, implementing, and maintaining effective, secure, and reliable technology.¹⁴

A consensus about how best to approach the challenging problems of developing such health information infrastructure has not yet emerged. Nevertheless, there is general agreement in the health information technology community that we do not have sufficient numbers of trained personnel to implement the NHIN regardless of the approaches that ultimately prove successful. If this generally accepted premise is correct, our nation could soon find itself in the unfortunate position of knowing how to build the NHIN but lacking the workforce needed to accomplish the task.

The strong tendency of community health information infrastructure projects is to engage the best available personnel, regardless of whether those individuals meet an objective standard of competence (which is admittedly difficult to define). If there is a shortage of qualified personnel, much of the NHIN work in communities is likely to be done by inexperienced and inadequately trained individuals who, as they rediscover well-known informatics principles, will inevitably make expensive and time-consuming mistakes. Such errors not only have a negative impact on an individual project, but also could be misinterpreted by others as evidence that the NHIN itself is not a viable idea. This might jeopardize projects across the nation, including those being effectively implemented by capable and experienced informaticians. This same scenario was observed in the 1990s with the development of community immunization registries, where inexperienced leaders repeatedly made costly errors leading to project failures, disillusionment, and substantial waste of financial and other resources. Compared to immunization registries, the NHIN work is even more complex and involves more stakeholders in a much greater level of change. Therefore, it is reasonable to anticipate that, absent effective intervention to improve the availability of needed informatics personnel, the implementation problems will be even worse.

This workforce problem has been recognized for several years. In 2001, before the current surge in NHIN development activity, the Department of Labor was already projecting a forty-nine percent growth in the demand for health information management workers by 2010.^{xv} The recommendations developed at the 2003 NHII meeting included increased clinical informatics training for both health professionals and clinical informatics specialists.¹¹ In 2005, the American Medical Informatics Association (AMIA) announced its intention to facilitate the education of 10,000 informatics specialists by 2010 with its "10 x 10" program.^{xvi} More recently, this workforce issue was the subject of a joint report from AMIA and the American Health Information Management Association (AHIMA) entitled *Building the Workforce for Health Information Transformation*.^{xvii}

The recommendations of the AMIA-AHIMA report include the following:

- Create incentives for health care professionals to acquire and maintain informatics skills.
- Develop a stronger health information specialist workforce.
- Define workforce competencies.
- Engage a wide group of stakeholders to develop a vision for expanding health information education in the future.
- Increase awareness of the need for expanded public- and private-sector funding of HIT training.
- Develop and apply tools for assessing and projecting workforce needs.

Specifically addressing this last recommendation from the AMIA-AHIMA report, the current research project aims to develop and apply tools to estimate the specific workforce needs for building the NHIN. While there is widespread agreement about the need for additional personnel, there are no existing tools that focus specifically on quantification of NHIN personnel needs. Availability of such estimates would greatly assist policymakers, educational institutions, professional societies, communities, and others to help address the expanding needs for trained personnel as the work on health information infrastructure across the nation continues to develop and expand.

II. Methodology

A. Overview

A fully functional NHIN requires both EHR systems for health care providers and institutions and a community-level infrastructure that links these systems to provide complete lifetime health records for all citizens. Thus, workforce estimates must include personnel for both EHR installation as well as the development of needed community infrastructure. Since EHR activities for health care institutions are quantitatively and qualitatively different from those in physician offices, these two areas also must be considered separately.

Therefore, the planned assessment of NHIN workforce requirements was focused on three distinct types of related activities: EHRs in physician offices; EHRs in health care institutions; and community infrastructure. The research plan consisted of four phases:

- 1) Development of the detailed research approach and framework for the workforce estimation model with input from domain experts (two expert panels);
- 2) Independent expert review and validation of the approach (two expert panels);
- 3) Site visits and other activities to further validate the model and gather additional data (five site visits); and
- 4) Synthesis, review, and validation of the resultant model with additional expert assistance.

B. Expert Panels

1. Selection Process

An extensive list of individuals with expertise in electronic records and health information infrastructure was developed. Particular attention was given to including people with specific expertise in workforce issues. After meeting dates were selected, invitations were sent and potential experts were matched with available dates if possible. Efforts were made to ensure a balance of expertise for every panel, but the composition of each was primarily dependent on the availability of participants.

2. Issues

The first two expert panels were asked to provide workforce estimates during the session. In addition, the questions posed to all four expert panels included the following:

- Are the study assumptions correct and complete? If not, how should they be modified?
- Are the limitations correct and complete? If not, how should they be modified?
- What are the important specific architectures for each type of infrastructure that need to be estimated?
- What are the important specific organization sizes and types that should be considered separately in generating workforce estimates?
- Are the three outcomes listed as necessary for each component of the estimate correct and complete? If not, how should they be modified?
- How long (calendar time) would implementations of each activity and architecture type require?
- What is the best feasible method to obtain reasonable estimated values of the key parameters for each architecture and for each infrastructure creation activity?

C. Site Visits

1. Selection Process

Five site visits were planned for this project: two to regional health information organizations (RHIOs), one to an institutional EHR, and two to physician office EHRs.

RHIOs selected for site visits needed to be: 1) fully functional, 2) as complete as possible, 3) representative of how other RHIOs are likely to be organized, and 4) likely to be able to provide good workforce data. These criteria, combined with scheduling and travel considerations, resulted in site visits to Bellingham, Washington, and Indianapolis, Indiana.

For an institutional EHR, a site visit was made to Citizens Memorial Healthcare in Bolivar, Missouri. In addition to an interesting hospital EHR system, they were selected because they are one of the very small number of organizations that have also installed an EHR in their long-term care facilities. In addition, they have experience installing EHRs in physician offices. Finally, their rural location provided some insights into EHR issues outside urban areas.

Site visits to physician EHR systems occurred in Portland, Oregon (the Oregon Community Health Information Network or OCHIN) and Fairfax, Virginia (Fairfax Family Practice). OCHIN was selected because it was a large multi-site EHR focused exclusively on Medicaid and underserved populations. Fairfax Family Practice provided two examples of EHR installations in a single local visit.

2. Issues for Site Visits

After describing the goals, objectives, and methods of study in detail, the key issue for each site visit was soliciting available workforce data that could be used for analysis. While each site visit organization was selected based on the availability of one particular type of workforce data (*e.g.*, physician office EHRs), data for other activity categories was also sometimes available.

D. Desired Outcomes

For each architecture of each separate NHIN implementation activity for each organization size and type, the goal was to develop estimated ranges for the following parameters (minimum, expected, maximum):

- Calendar time that an individual unit implementation (*e.g.*, individual physician EHR installation) would take;
- Specific types of professionals needed for the implementation; and
- Time needed from each type of professional.

The overall workforce estimate could then be obtained by specifying: 1) the total calendar time available for all implementations; 2) how many implementations would be needed for each activity comprising development of the entire NHIN; and 3) the fraction of implementations that would use each available architecture for each activity for each organization size and type. The overall workforce would then be the sum of the estimated workforce needs for each activity, organization type and architecture.

III. Literature Review

A brief review of the literature was conducted for this research. As indicated in the Introduction, the recent expert consensus report from AHIMA and AMIA expressed serious concerns about potential shortages of trained HIT personnel.¹⁷

However, workforce issues have been a concern for a number of years. In 2000, a survey of 18 health care organizations regarding the role of health care informaticians concluded that there was an increasing role for personnel with combined expertise in health care and IT.^{xviii} In 2002,

Masys described “opportunities for new kinds of employment in health related professions” based on the growth of health IT.^{xix} That same year, the British National Health Service (NHS) released its human resources strategy for health informatics, stating that “to support this level of new investment in technology will require a significant level of recruitment of new staff as well as in the development of existing staff to maximize their contribution.”^{xx} In 2003, Australia released a plan for building the capacity of the health information workforce noting “strong anecdotal evidence” of the need for additional trained personnel.^{xxi}

In 2006, the NHS issued a follow up report that surveyed their informatics workforce, detailing progress since the 2002 plan.^{xxii} That report estimated the NHS informatics workforce to be 25,000 FTEs, with the expectation that substantial additional personnel would be needed over the next few years (although there were no specific quantitative estimates). Challenges to expanding their workforce include problems with recruitment and retention related to both difficult working conditions and uncompetitive pay scales. Hersh^{xxiii} reviewed the issue of the health information technology workforce in 2006, dividing it into clinicians, IT professionals, health information management (HIM) professionals, and health science librarians. He noted that there were “no data [that] provide an overall picture of those who work with HIT.” Finally, there has been particular concern about the challenges of recruiting and maintaining the informatics workforce in public health. While a recent report from the Association of State and Territorial Health Officials^{xxiv} contains no quantitative current or future workforce estimates, it notes that the “public health informatics workforce... is vital to fostering integration among public health information systems in order to improve the efficiency of public health services and maximize the utility of public health data.”

In summary, despite the continuing concerns about the HIT workforce, no prior studies have developed quantitative estimates of the future need for HIT personnel in the United States.

IV. Data Analysis

The number of usable workforce data estimates was eight for physician office EHRs, four for hospital EHRs, and two for community HII systems. For each type of system, the average workforce requirement per installation was calculated. For physician offices, the installation unit was considered to be a single physician. Therefore, workforce data for physician group installations was divided by the number of physicians to normalize them for comparison with the other estimates. For hospitals, a single hospital was considered to be one installation (with no differentiation based on size). No data was available for health care institutions other than hospitals.

Since there were eight data points for physician EHRs, the standard deviation for the distribution of values was calculated. These final workforce estimates are stated as the average +/- one standard deviation. For the other two activities, the number of data points was considered too small to justify distributional statistics.

The resultant workforce estimates are based on five years of implementation time, 400,000 physicians needing EHRs, 4,000 hospitals needing EHRs, and 300 communities requiring health information infrastructure. The calculations assume that the same personnel are available for

multiple installations during the 5-year time frame. Therefore, decreasing the total time increases the workforce requirements.

V. Results

A. Expert Panels

In the first two expert panels, participants were asked to estimate the number of hours for various types of personnel (which they specified) to install an EHR system in various settings (which they specified) using various architectures (which they specified). In the first expert panel, they also were asked to provide similar estimates for HII in a community using two different architectures. A Delphi procedure was used, whereby the participants submitted their results anonymously and were then able to see all the results for the group and modify their initial estimates.

The estimates had a huge range – typically an order of magnitude, but sometimes two or even more orders of magnitude. Also, the substantial changes in individual estimates resulting from “reasonableness” discussions indicated that most panel participants were really “guessing” rather than sharing meaningful data. This was further reinforced by the extremely wide ranges in the data. From all this, it was concluded that the work hours estimates could not be reliably extracted “on the fly” from experts during group meetings.

The discussions about activities needed to complete the NHIN, architectures for the activities, and the personnel types needed were very helpful. While very little time was spent soliciting views on the calendar time needed for each type of implementation project, the information obtained on this topic was also helpful.

The third and fourth expert panels provided additional focused feedback and guidance about the study, omitting any further data collection. The participants confirmed the overall strategy and direction of the research. In addition, the experts agreed with the planned “off-line” data collection and provided suggestions of sources to contact for this purpose.

B. Site Visits

1. Indianapolis, Indiana

The Indiana Health Information Exchange (IHIE) is a well-known and highly regarded community health information system. In a half-day session, the Chief Executive Officer of IHIE reviewed the presentation about the study and provided useful feedback. He also was able to provide data regarding the Regenstrief Institute's experience with installations of standardized physician EHR systems over many years.

2. Portland, Oregon

The Oregon Community Health Information Network (OCHIN) is a collaborative effort providing EHR services to multiple safety net clinics. It is funded primarily by the clinics based on the benefit they receive from the economies of scale. OCHIN provided two sets of helpful EHR workforce data as well as other useful information.

3. Bellingham, Washington

Bellingham has perhaps the most experience with the deployment of personal health records (PHRs), with nearly 1,000 patients using them. They are populated with data from the hospital information system (since there is only one hospital, this is much easier to do than in larger communities). They provided workforce data for their widely recognized community health information infrastructure known as the Whatcom Health Information Network (HInet).

4. Bolivar, Missouri

Citizens Memorial Healthcare operates a 74-bed hospital and five long-term care facilities and has installed about 15 office EHR systems. They shared useful data about their office EHR workforce requirements and detailed overall workforce data related to all their installation activities.

5. Fairfax, VA

This group practice has 10 sites with 70 physicians and about 350 total employees. They are running two separate EHR systems, one at a single three-physician site, and the other larger system at most of the other locations. They shared their experience with EHR workforce requirements.

C. Final Workforce Results

Assuming a 5-year time frame for NHIN implementation, results indicated that 7,579 (+/- 3,736) specialists are needed for installation of EHRs for the approximately 400,000 practicing physicians who do not have them already. For the hospitals needing EHRs (4,000), 28,620 specialists are needed. Finally, 416 people are needed to build the HII systems in communities to interconnect all these EHR systems. It is notable that there is no available data about the current number of specialists working in the three areas, so it is not clear if these estimates indicate a shortage of personnel.

VI. Discussion

A. Lessons Learned

The initial goal was to collect profession-specific workforce information from each expert panel for each type of implementation: physician office EHR, institutional EHR, and community health information infrastructure. It was also important for the experts to validate and contribute to the overall study approach, assumptions, and limitations.

With respect to the overall approach of the study, there was general consensus that collecting data on specific activities needed to implement the NHIN and then building a tool to use that data for an overall workforce estimation made sense. There was also universal agreement that there is a workforce problem – *i.e.*, at this time, we do not have the trained professionals we need to fully implement the NHIN. The experts also were unanimous in welcoming the effort to begin to quantify this problem with the current research.

However, there were a number of difficult issues. First, there is not consensus on the types or definitions of health IT professions involved in NHIN work. We were able to elucidate fifteen different types of personnel and develop definitions that were generally acceptable (Table I). However, each expert panel wanted to add additional subtypes and variants.

Another difficult problem was the categorization of different types of EHR implementations, both in terms of the type of organization and the architecture of the installation. It is generally agreed that an EHR installation in a solo practitioner's office is quite different from one in a large multispecialty group practice, but creating meaningful and consistent categories is problematic. Initially, it was suggested that the number of physicians should be the key parameter for categorization. However, other experts suggested that it is the decision-making process in a practice that differentiates small and large installations. When one person is making decisions, the process is faster and more efficient than when several people or even several committees must be involved in each implementation step. The final categorizations we attempted to use were a hybrid of these approaches (Table II).

Finally, it was hoped that the experts would be able to provide profession-specific estimates of the personnel types and time required for EHR installation in various settings. However, the tenfold (or greater) variance observed in these estimates (even after discussion among the experts) clearly indicated that the results were quite speculative and largely the result of guesses.

The expert panelists themselves suggested that the best sources of data would be the EHR vendors, since they actually deploy staff for EHR installations on a regular basis. Accordingly, the members of the EHR Vendors Association were asked to submit data anonymously to assist in compiling information for this research. However, only a very small number of vendors had responded to this request as of this writing. Possible reasons for the lack of response include insufficient time, proprietary concerns, and low priority for support of such research activities.

There were even more difficult problems for collection of data regarding the personnel needed to build community health information infrastructures. First, only a handful of communities have operational systems and, therefore, could be considered to have completed the implementation process. Second, each community's system is different and, therefore, not necessarily comparable to any of the others. This also reflects the fact that a consensus has yet to emerge regarding the best architecture for creating such systems. Finally, because of the long-term nature of the projects, the varied funding, and the typically extensive in-kind contributions of time, communities may not have accurate records of personnel types and time that have been used.

The experts were very helpful in clarifying and adding to the initial list of assumptions for the current research. In particular, the focus of the present study on the implementation phase of EHR systems needs to be emphasized. While it is clear that additional personnel time is necessary to plan for EHR implementation and that personnel are needed for maintenance after the installation, the present study attempted to focus exclusively on the implementation period only. Furthermore, additional burdens placed on current personnel were excluded, as the goal was to determine what additional workers are needed. A complete list of the assumptions is shown in Table III.

Similarly, the expert panels were quite helpful in expanding the scope of limitations for this study. For example, the short duration of this project and the planned methodology depended exclusively on capturing existing data as opposed to making new, independent observations of the workforce used for various EHR installations. The complete list of identified limitations is shown in Table IV.

In that context, the limitation with respect to attrition of the workforce (# 18) needs to be specifically highlighted, particularly as it has a substantial impact on the interpretation of the personnel estimates for physician office EHR installation. Given the short estimated installation time (23.7 FTE days -- or about 10 installation cycles per year), even a small attrition rate of personnel for each installation cycle could result in a substantially increased workforce need. For example, a 10% attrition rate over 10 cycles per year would mean that the entire workforce would need to be replaced each year. In other words, to maintain the needed workforce of 7,600 FTEs, an additional 7,600 workers would need to be added every year. Therefore, while the number of FTEs performing installations would not change over time, the number of actual personnel that would be needed is 7,600 each year (or a total of 38,000 in five years). Since there is substantial anecdotal evidence that some personnel performing EHR installations in physician offices are commonly retained by the practice for ongoing support and maintenance, this is an important factor to consider. Note that this has much less impact in the areas of hospital EHRs and community health information infrastructure systems because of the longer installation times.

B. Workforce Estimation Tool

To assist in the further understanding and use of the results of this research, a workforce estimation tool has been developed (Table V). In the Workforce Estimation Tool spreadsheet, the variable assumptions representing the time allotted for completing the NHIN (5 years), number of physicians needing EHRs (400,000), number of hospitals needing EHRs (4,000), and number of communities needing health information infrastructures (300) are clearly indicated. These values may be changed by the user of the tool and the resultant estimates of workforce (which are calculated based on these assumptions) will change accordingly.

Note in particular that for the hospital EHRs and community HII, there is a calculated value called “*N* implementation cycles.” Since the anticipated period for implementation of these types of systems are long (17.3 and 15 months, respectively), this item represents the number of complete sequential implementations that can be done in the overall period specified for completing the NHIN. In the example shown, only three complete 17.3-month periods can occur in 5 years for hospital EHRs, while four 15-month periods can be accommodated for community HII. Since the implementation period for a single physician’s EHR is so short (about 23 days), there was no need for a similar calculation to avoid counting incomplete projects of that type.

As an example of the type of analysis that is possible with this tool, Figure 1 shows the changes in the workforce estimates when the time to complete the NHIN is varied from 2 to 8 years. The workforce requirements for physician office EHRs, hospital EHRs, and community HII are shown separately.

VII. Conclusions

Assuming a 5-year time frame for NHIN implementation, about 7,600 (+/- 3,700) specialists are needed for installation of EHRs for the approximately 400,000 practicing physicians who do not have them already. For the hospitals needing EHRs (about 4,000), approximately 28,600 specialists are needed. Finally, about 420 people are needed to build the health information infrastructure systems in communities to interconnect all these EHR systems.

These estimates are admittedly imprecise and preliminary, and should be interpreted in the light of the numerous limitations of the current research (Table IV). Since no quantitative data is available regarding the existing NHIN workforce, it is not possible at this time to determine whether these workforce needs are indicative of a shortage of personnel. In addition, further research is needed to determine the accuracy and reliability of these estimates. Nevertheless, these first-ever estimates of the NHIN workforce requirements will provide critical help and guidance in our ongoing efforts to bring the benefits of electronic health information to all Americans.

Table I. Types of Personnel Identified

1. **Project Manager** – Overall responsibility for all aspects of implementation of an information system, including supervision and direction of other involved personnel
2. **Implementation Coordinator** – Overall responsibility for ensuring that the implementation team works effectively together with the end users
3. **IT Interface Builder** – Creates effective data communications interfaces between systems, including (as necessary) connecting hardware and installing, modifying, and developing software
4. **Change Management Specialist** – Works directly with end users to ensure a smooth and effective transition of their current business processes to an EHR system
5. **Desktop Specialist** – Works on PC-related issues for implementation, such as configuration, software installation, and establishment of communications
6. **Database Administrator** – Responsible for the definition, operation, protection, performance, and recovery of a database
7. **Network Engineer** – Responsible for design, implementation and support of local-area and wide-area computer communication networks
8. **Records Management Specialist** – Ensures accuracy, integrity, and completeness of medical records as a practice makes the transition to an EHR
9. **Quality Assurance Specialist** – Works with end users to test each component of the information system and assure that the components work effectively with each other as they are integrated
10. **Privacy Officer** – Ensures that privacy policies for medical records follow all relevant laws and regulations and that the organization's policies and operational practices are consistent with them
11. **Security Officer** – Ensures the implementation and operation of reliable and consistent mechanisms that effectively enforce privacy and confidentiality policies in health information systems
12. **Technical Analyst** – Works with system personnel and end users to identify and correct any problems with operational information systems
13. **Trainer** – Works with end users to educate them about the features and proper operation of their information system
14. **Help Desk Specialist** – Works with end users to troubleshoot problems and questions that arise in the course of routine use of their information system
15. **Chief Medical Information Officer (CMIO)** – Ensures that all medical information systems are working effectively for patients, providers, and the organization

Table II. Proposed Activities, Organization Types and Architecture Types

1. EHR implementation in provider offices (small, medium, large, very large)
 - Architecture #1:* Each provider has an independent system
 - Architecture #2:* Each provider uses an ASP-model EHR via a browser

2. EHR implementation in institutions (small or rural hospitals, community hospitals, large hospitals, academic medical centers or hospital chains, long-term care)
 - Architecture #1:* Each institution has an independent system
 - Architecture #2:* Each institution uses an ASP-model EHR via a browser

3. HII implementation
 - Architecture #1:* All information stays in place and is gathered only when needed (scattered model)
 - Architecture #2:* Each patient's information is gathered in advance and stored in a health record bank

Categorization of Provider Offices

1. Small – no practice manager (about one to five physicians)
2. Medium – practice manager; decisions made by single physician leader (~6–20 physicians)
3. Large – practice manager and staff; decisions made by committee (~21–100 physicians)
4. Very large – more than 100 physicians; all have EHRs already so excluded from this study (small number total so minimal impact on workforce estimation)

Categorization of Hospitals

1. Small or rural – no CIO (25 beds or fewer)
2. Community – CIO but no staff (~26–149 beds)
3. Large – CIO and support staff (~150–499 beds)
4. Academic medical centers or hospital chains – complex decision-making – CIO or CMIO with support staff (medium-to-large number of beds)

Table III. Assumptions

1. NHIN creation requires three identifiable infrastructure development activities:
 - (1) Implementation of EHRs in provider offices
 - (2) Implementation of EHRs in institutions (*e.g.*, hospitals)
 - (3) Implementation of the infrastructure to make complete records available for each patient (HII)

Each of these areas is composed of multiple individual implementations.

2. Within each activity, there are subsets that depend on the size and type of the organization (*e.g.*, small provider offices vs. large group practices); these subsets influence the workforce needs
3. Within each activity and organization size or type, the specific architecture for implementation (*e.g.*, independent system vs. ASP model) will impact the workforce needs
4. By estimating the workforce needs for each specific activity and architecture, a model can be created to estimate workforce for any specified mix of activities and architectures

Table IV. Limitations of the Research

1. This is the first attempt to quantitatively estimate NHIN workforce needs.
2. Estimates are based primarily on expert opinions.
3. Overall workforce estimates are highly dependent on activities identified using current perspectives on building the NHIN, which may change.
4. Precision of the estimates is difficult to assess.
5. Only five site visits were done for preliminary validation.
6. New technologies or implementation architectures, such as improvements in EHRs, could invalidate results.
7. Only personnel needed for implementation are addressed. Workforce needs for pre-implementation planning and post implementation maintenance, support, and upgrades are outside the scope of this study.
8. Only personnel needs outside existing organizations are included. Additional work required by existing personnel is not assessed.
9. The impact of the ongoing establishment and selection of standards and use of structured versus free-text data cannot be estimated within the framework of this project.
10. Differences of EHR installation by practice specialty cannot be estimated within the framework of this project.
11. The impact of “affiliated” versus “independent” practices cannot be estimated within the framework of this project.
12. The impact of multispecialty versus single-specialty group practices cannot be estimated within the framework of this project.
13. This study does not account directly for economies of scale from simultaneous installation of large numbers of EHR systems.
14. This study does not include the workforce needed for the entire transformation of health care. Informatics skills are needed for this.
15. Estimates of workforce for HII deployment in communities are limited by the small amount of available data, the uniqueness of each current instance, and the absence of any fully operational HII systems today.
16. Differences due to the state of readiness of a practice or institution for EHR installation could not be assessed.
17. Potential workforce efficiencies gained over time from the experience of many installations could not be estimated.
18. The effect of retention of installation personnel by practices and institutions for ongoing operation and support (after initial EHR installation) was excluded and may result in substantial underestimates of the numbers of personnel required.
19. This study did not include estimates of the workforce needed to install personal health records.
20. The current estimates do not account for any interactions with other related health care workforce needs (*e.g.*, the shortage of nurses).

Table V. Workforce Estimation Tool

NHIN Workforce Assessment Tool 9/24/07 final version

FIXED ASSUMPTIONS Business Days/Year 250
 Months/Year 12

VARIABLE ASSUMPTIONS Yrs to Implement NHIN 5
 N of physicians 400,000
 N of hospitals 4,000
 N of communities 300

PHYSICIAN OFFICE EHRs

	Min	Average	Max
FTE days per physician	12.00812	23.68577	35.36343
FTE years per physician	0.04803	0.09474	0.14145
TOTAL FTEs NEEDED	3,843	7,579	11,316

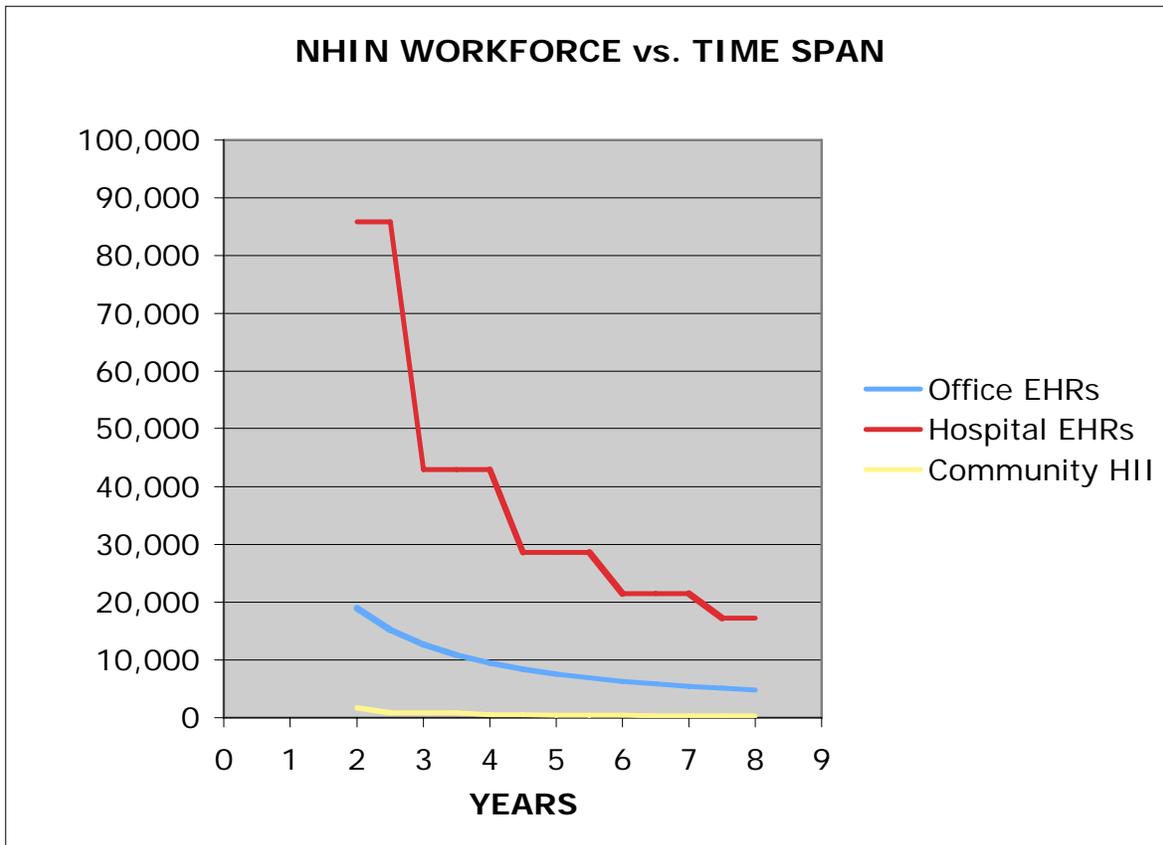
HOSPITAL EHRs

Avg Implementation Time	17.3 months
N Implementation Cycles	3
	Average
FTE Years per hospital	21.46
TOTAL FTEs NEEDED	28,620

COMMUNITY HEALTH NETWORKS

Avg Implementation Time	15 months
N Implementation Cycles	4
	Average
FTE Years per community	5.55
TOTAL FTEs NEEDED	416

Figure 1. NHIN Workforce Estimates Versus Time Available for NHIN Implementation



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