The Role of Innovative Technologies in Improving the Quality of Patient Care:
Training Implications for the Health Workforce

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Center for Health Workforce Studies
University at Albany, State University of New York

Center for Health Workforce Studies
University at Albany, State University of New York
School of Public Health
7 University Place / Suite 334
Rensselaer, NY 12144-3458
http://chws.albany.edu
(518) 402-0250

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Executive Summary

The attention directed at the use of technology in health care has grown tremendously over the past few years. Most planners and policy-makers recognize a great potential for technology to reduce medical errors, help contain the costs of providing care, and improve patient outcomes. The relatively low level of current technology adoption, paired with the increasing pressure to accelerate technology adoption, may result in a demand for health workers experienced with new technologies that far exceeds the supply. Workforce training in technology will become an increasingly important issue throughout the country over the next several years.

This project investigated the latest developments in health care technology, prevalence of various types of technology in New York City area hospitals, and the impact of technology adoption on training needs for health care workers. The 1199 Hospital League Health Care Industry Planning and Placement Fund funded this project in order to inform planning of training programs targeted to New York City health workers.

Study methods included a review of the literature on emerging health care technologies and the implications for the health workforce, site visits to selected New York City hospitals to view new technologies in use and talk to workers and their supervisors about their training needs and experiences, telephone interviews with facility representatives about their current and future use of new technologies, and participation in a technology conference sponsored by City University of New York about current and planned use of new technologies.

The first section of the report describes the findings of the literature review, while the second section presents the results of the site visits and interviews at New York City hospitals. The study identified five major categories of technology emerging in health care that were of growing interest to the hospitals: electronic medical records, telehealth, clinical technology, distance learning/continuing education, and other technologies.

Key Findings

- Technology adoption in New York City hospitals is currently very uneven, with some health care providers taking the lead and others doing very little.
- Funding is a large issue – both funding the purchase and set-up of the product and funding the training for the staff.
- Interoperability (the ability of systems to interface with one another electronically) is a serious issue both within and between facilities, and can limit the potential of electronic systems and make the recruitment of workers with the requisite skills more difficult.
- Technology products and systems vary widely by vendor, and expecting new hires to be trained to a specific system often is not realistic. Most training is vendor-driven, and often is done by vendors or by facility personnel.
- There will be increasing demand for basic computer literacy for the growing number of health care technology end-users.

- Demand for support people, such as medical informatics and information technology professionals, is expected to grow.
- Exposure to and use of technology should be integrated into the curricula of education programs for all health professionals.
- There are gaps between the skills health workers will need as use of technology in health care increases and their current skills.

I. Introduction

Interest in the use of technology in health care has grown tremendously over the past few years. Most planners and policy-makers recognize a tremendous potential for technology to reduce medical errors, help contain the costs of providing care, and improve patient outcomes. A briefing paper produced by the eHealth Initiative Foundation in January 2005, stated "The national dialogue on health information technology (HIT) has moved from 'whether this should happen' to 'how this should happen.' " (pg. 1)

Federal policy is currently directed at facilitating the development and adoption of health information technology. In 2004, the Secretary of the Department of Health and Human Services (DHHS), Tommy Thompson, appointed the first National Coordinator for Health Information Technology. A few months later, Thompson and the new Coordinator, David Brailer, produced a detailed *Framework for Strategic Action* that proposed strategies for the national implementation of an electronic medical record (EMR) within the next ten years.

In addition, the new Secretary of DHHS, Michael Leavitt, has announced his intention to make information technology in health care a priority and has convened an advisory panel called the American Health Information Community (AHIC) to develop standards for interoperability, i.e. the ability of different systems to communicate electronically (Commonwealth Fund, 2005).

A number of states are also studying the issue, and interest is increasing in the private sector as well. For example, the Leapfrog Group, a consortium of for-profit organizations that promotes the safety, quality, and affordability of health care, has identified health information technology, particularly Computer Physician Order Entry, (CPOE) as one of the cornerstones of their strategy.

In sum, the widespread implementation of new health care technologies is not merely probable, but inevitable. Despite this eventuality, it does not appear that New York City health care providers are leaders in adopting health care technology, and may in fact be behind other areas of the country. The relatively low level of current technology adoption, paired with the increasing pressure to accelerate implementation, may result in a demand for health workers experienced with new technologies that far exceeds the present supply. Workforce training in technology will become an increasingly important issue in the New York City area over the next several years.

This project investigated the latest developments in health care technology, the prevalence of various types of technology in New York City area hospitals, and the impact of technology adoption on training needs for health care workers. The 1199 Hospital League Health Care Industry Planning and Placement Fund funded this project, in order to inform planning of training programs targeted to New York City health workers.

Methods used included a review of the literature on the adoption of health care technology and the implications for the workers, site visits to selected New York City hospitals to view

new technologies in use and talk to workers and their supervisors about their training needs and experiences, telephone interviews with facility representatives about their current and future use of new technologies, and participation in a technology conference sponsored by City University of New York about current and planned use of new technologies.

The first section of the report describes the findings of the literature review, while the second section presents the results of the site visits and interviews at New York City hospitals. The study identified five major categories of technology emerging in health care that were of growing interest to the hospitals: electronic medical records, telehealth, clinical technology, distance learning/continuing education, and other technologies.

II. Literature Review

There is much literature examining the potential of health information technology to improve the delivery of health care in the U.S. According to the synthesis presented in the DHHS *Framework for Strategic Action*, the use of HIT has been found to:

- reduce medical errors;
- increase use of recommended interventions;
- reduce adverse drug interactions;
- reduce laboratory and radiology test ordering;
- reduce hospital admissions; and
- reduce excess medication usage.

Furthermore, there is potential for technology to accelerate diffusion of knowledge, reduce variability of care, advance the consumer role, strengthen privacy and data protection, promote public health and preparedness, interconnect clinicians, and abet personalize care. Despite these demonstrated and potential benefits, however, the adoption of innovative technology is both slow and uneven.

Everett Rogers (1962) proposed the most widely accepted and cited model of the diffusion of innovation. Of particular interest for informing this discussion are Rogers' five stages of adoption: awareness of the innovation, interest, evaluation, trial, and adoption. Innovations may be rejected at any stage of the adoption process, and the decision process hinges on conditions such as previous practice, perceived needs and problems, innovativeness, and the norms of the social system, as well as characteristics of the innovation such as relative advantage, compatibility, and complexity. While there is growing awareness of and interest in health technology such as electronic medical records (EMR), it is less clear how many facilities are in the evaluation, trial, or adoption stages.

In a later work, Rogers (1995) proposed five categories of adopters that are particularly relevant to the current study: innovators, early adopters, early majority, late majority, and laggards. Despite the growing importance of health technology, particularly health information technology, only the innovators (defined as the first 2.5% in a social system to adopt an innovation) have currently implemented fully paperless systems, and only the early adopters (defined as the next 13.5% to adopt an innovation) have currently made the

transition to full electronic medical record (EMR) systems. The remainder of the facilities who have not yet adopted these technologies will ultimately become early majority adopters (34%), late majority adopters (34%), or laggards (the last 16%). Those who are currently constructing concrete implementation plans will probably become early majority adopters.

A. Electronic Medical Records

Latest developments in electronic medical records. Although the most basic EMR system is simply a central database where all patient records are housed electronically in one place, there are a number of potential add-ons to EMR systems. Good EMR systems include results reporting of tests, prescription drug ordering and filling, and digital archiving of images (MedPAC). Some hospitals equip their clinical staff (including physicians and RNs) with handheld computers to facilitate entries into the EMR. Others provide computers outside patient rooms so that everyone from physicians to nurse aides can enter and review data. Some systems include digital pens that record and transcribe handwriting, or voice recording for data entry and collection of narrative (Walsh, 2004).

In addition to simply holding patient records, EMR systems can be used for computerized provider order entry (CPOE) for drugs, lab tests, and procedures (MedPAC). Some incorporate clinical decision support tools that stimulate clinical reasoning: differential diagnosis, prompting, reminders, references, risk calculators, decision trees, and best evidence resources (Walsh, 2004). Such systems can even be linked to radio frequency identification: chips placed inside hospital wristbands with identification information and access to medical records in hospital database.

The potential inherent in such systems is enormous. When interoperability between organizations is achieved, systems can be accessed by providers, payers, and labs. There is even the possibility for Web-based access for both providers and patients (Wiesenthal, 2004). Eventually, patients may have access to their EMR in portable format to be taken to emergency departments and other providers. Furthermore, organizations can use these systems to collect data for analysis to inform decision-making (Wing and Langelier, 2004).

Prevalence. Most hospitals now have electronic billing alone (without EMR), which was required by CMS as of July 2005 for any facility billing Medicare. Under the Health Information Portability and Accountability Act (HIPAA), facilities using electronic billing must use standard formats. Although the electronic billing system often becomes the platform from which EMR systems are launched, only 13% of hospitals had electronic health records systems in 2002 (CCN article). Other technologies are even less common; only 5-6% of hospitals have medication ordering and filling systems (MedPAC).

When changes occur, however, they can occur rapidly. In 2002, 15% of hospitals had picture archiving; in 2004, 49% of hospital executives reported either having or being in the process of implementing such systems (MedPAC). It is difficult to predict what systems will be the "next big thing," but surveys of information systems directors indicate that bar coding (for medication management), EMR, and clinical information systems will become the most important technologies over the next two years (MedPAC). Factors that will facilitate the

increased use of technology include: declining prices for information technology; electronic transaction standards; and FDA bar-coding requirements (MedPAC).

Who uses electronic medical records? Clearly, physicians are central to the EMR system, but new systems will incorporate the work of more clinical staff such as nurses and allied health professionals into EMR. For example, nurse aides may be expected to access the system for basic tasks such as entering vital signs. Some systems include features specifically designed for non-physician personnel -- for example, there are some packages that allow nurses to use PDAs to access content from professional books and journals immediately at a patient's bedside.

In addition to personnel who use the system, the creation of EMR systems requires professionals to design and manage HIM systems, as well as IT support staff. Therefore, there will also be a need for professionals to provide expert advocacy and education services (Wing and Langelier, 2004).

What new training needs result from the use of electronic medical records? Clearly, the use of electronic medical records requires basic computer literacy. Beyond this, however, users may need a command of coded languages and standard nomenclature, data mining and analysis skills, knowledge of legal and regulatory standards, and familiarity with relational databases (Wing and Langelier, 2004).

Are electronic medical records well-accepted? There are both costs and benefits for facilities to implement EMR systems. On the one hand, EMR can reduce duplicate treatments, hospital length of stay, and time in intensive care -- potentially reducing hospital revenues. On the other hand, money is saved in data collection, especially dictation and transcription.

Individual providers may have mixed feelings about EMR and computerized provider order entry (CPOE) systems, as well. One study in Australia found that nurses and midwives reported mostly negative experiences with Computerized Patient Information Systems (CPIS), primarily because the systems were difficult to use and seen as irrelevant to patient care. In addition, reading text on a computer screen is up to 40% slower than reading printed text (Walsh, 2004), and systems such as CPOE may add to provider workload (MedPAC).

B. Telehealth

Latest developments in telehealth. Telehealth indicates a variety of different health technologies, including using the Internet to access an online EMR for the co-management of chronic disease, wireless devices that transmit patient data (e.g., heart monitor readings) to care providers, interacting with a health care provider through e-mail or live chat, or actually interacting with live care providers in real time via a video link. In the first type of program, Web-based applications allow patients to co-manage diseases such as diabetes from home by uploading blood glucose readings; entering medication, nutrition, and exercise data into an online diary; communicate with providers using clinical e-mail; and browse education sites.

Obviously, such applications are tied to some version of an online EMR, and require care management by a health professional.

The latter type of application is currently used primarily in home care, addressing issues from wound care to mobility assessments to a patient who is having difficulty understanding medication instructions. Although higher-level staff, such as wound-care specialists, can use video link technology for some of their work, patients must still be attended in person by care givers, including home health aides.

Prevalence. It is not clear how common telehealth services are. They are likely to prove more useful in rural areas, although as stated above, they have broad applications in home care.

Who uses telehealth? Telehealth technology appears to primarily be used in home care nursing, with nurse practitioners or registered nurses serving as care managers. This technology will also change the roles of home health aides, who may have more direct patient contact than the home care nurse who may rely more on 'virtual' home visits.

What new training needs result from the use of telehealth? Personnel, both professional and paraprofessional who use telehealth technologies primarily need to know how to set up and use the equipment and software (e.g., video links, Web cams, etc.) as well as to train patients on its use. They may also need some additional training in performing clinical assessments when they are not viewing the patient face-to-face.

Is telehealth well-accepted? Once again, telehealth appears most often used in agencies where patients are receiving health care services in the home. Although the use of basic telehealth technologies like e-mail is growing in ambulatory care, they remain relatively uncommon.

Are staff members able to get the appropriate training? Currently, agencies that use telehealth technologies train their workers in the use of these technologies. However, it does not appear that organizations try to recruit new hires with telehealth experience, although as these technologies become more common this could change. Basic computer literacy will increasingly become a hiring requirement in these agencies.

C. Clinical Technology

Latest developments in clinical technology. Some of the greatest uses of new technology have occurred in imaging -- x-rays and other scans can now be saved electronically, as can x-ray "movies." The use of digital images instead of radiological films means that images can be accessed throughout the hospital and even off-site, resulting in shorter turnaround times for test results. New procedures in imaging, such as fused hardware technologies (e.g., PET/CT scans) are also becoming increasingly common.

Some facilities have automated laboratories that process various tests (e.g., blood work) while reducing the need for workers to physically handle specimens, while in other labs

voice-recognition equipment allows technicians to enter data and handle specimens almost simultaneously.

Technology is also increasingly being adopted for monitoring. Wearable sensors are now available that can allow patients at home or in ICUs to be continuously monitored electronically.

Prevalence. New imaging technology is being rapidly adopted, and is aggressively marketed by vendors. Monitoring technology does not appear to be as common. Laboratory automation is also limited to a relatively few "cutting-edge" facilities.

Who uses clinical technology? Changes in imaging primarily affect physicians, but nurses often use monitoring technology in managing patient care. Laboratory automation affects the work of pathologists, laboratory technicians, and laboratory technologists, but if laboratory results are uploaded to a central database, many other types of clinical staff may need to be able to access and use the system.

In radiology and nuclear medicine, fused hardware technology (for instance, PET/CT) will require new skills of both the technologist and physician workforce. Technologists currently working in nuclear medicine will need training in radiology modalities and technologists working in radiology will require education in nuclear medicine. Currently, these skills are provided in different technologist education programs.

What new training needs result from the use of the new technologies? The literature on training needs is relatively limited, but since the adoption of clinical technologies appears vendor-driven (similar to the adoption of new pharmaceuticals), training is likely to be provided by the vendor. These technologies by and large also involve the application of new tools to existing clinical skills and do not require personnel to learn new competencies. It is anticipated, however, that the integration of new clinical technologies into health professional education programs will occur much more rapidly than the integration of new information technologies. As the new technologies increasingly become standard, appropriate technology skills will be expected of graduates of such programs.

D. Distance Learning/Continuing Education (CE)

Latest developments in CE distance learning. Most health professions require continuing education (CE) credits in order for personnel to maintain their credentials. CE is also a way for facilities to educate staff about the latest best practices within their field. Traditional avenues for CE include courses, workshops, and programs at conferences. New avenues opened by technology include modules that are Internet-based or available on a facility network, as well as academic courses offered by colleges and universities over the Internet.

Prevalence. There is little literature on the use of distance learning and other network-based CE by individual health facilities, although colleges and universities are increasingly implementing distance learning programs.

Who uses CE distance learning? Network-based CE can be extended to any workers who require CE to maintain credentials or who need to be educated about best practices or new practices. Network-based CE can be promoted by facilities in several ways -- by making CE units available on an in-house network (and perhaps requiring completion of a certain number of units), or by facilitating the involvement of their workers with external programs that allow them to complete CE on-line. It is not clear that personnel are aware of their CE distance learning options and this may be a significant area for human resource personnel to develop. There are many facilities where lower-level personnel do not have access to e-mail, an in-house network, or the Internet as part of their job and the prospect of distance learning in training these personnel is limited. At the same time, as these systems are put into place there is great potential for network-based CE programs to extend to all workers.

E. Other Technologies

Latest developments in other technologies. As well as using new technologies for the management of information, the treatment of patients, and the training of staff, there are new technologies available for hospitals to manage time, staff, and materials.

Technologies used to manage time include the use of e-mail or text messaging to mobile phones to remind patients about hospital outpatient appointments, and technology to standardize the informed consent process with paperless electronic capture of signatures. Patient reminders by text messaging mobile phones is now used in the United Kingdom by their National Health Service, and has been reported to save hospitals money by reducing missed appointments (Clothier, 2004).

Technologies used to manage staff include the use of fingerprint scanners for security (sometimes used in combination with other technologies such as courier robots), and the use of wireless radiophones to page staff (including housekeeping staff, nurses, and pharmacy workers). Automated bed-tracking systems also exist that allow housekeeping staff to be notified immediately when a bed is ready to be changed, reducing lengthy waits for admission in emergency departments.

Technologies used to manage materials include the electronic tracking and management of inventory of medical supplies, pharmaceuticals, and other materials (MedPAC); the use of computerized prescription databases and pharmacy systems; the use of automated dispensing machines to distribute medication doses or automated courier robots for delivering supplies (for example, blood samples to laboratories); and radio frequency identification for materials such as blood for transfusions and surgical instruments. The most sophisticated automated pharmacy systems sort, store, and dispense bar-coded medications with minimal handling of the drugs by pharmacy staff.

Prevalence. It is not certain how widespread these other types of technologies are, although it appears that facilities find it easier to adopt such technologies (which can provide an immediate cost savings and only involve a limited subset of departments or personnel), than to adopt technologies such as electronic medical records.

Who uses these other technologies? Unlike many of the other technologies discussed, which have the largest impact on the work of physicians and perhaps nurses, these "management technologies" are potentially applicable to almost any type of employee, and perhaps will have greater effects on lower-level personnel than on highly trained personnel such as physicians. Training needs depend upon the exact system being used, but for many staff members, it will be limited to basic procedures such as entering a password to access a computerized medicine chest. For some personnel (e.g., those who work in hospital pharmacies or store rooms), the changes have greater potential to affect the minute-to-minute practice of their jobs.

Are these technologies well-accepted? The degree to which staff members accept implementation of these technologies is likely to depend upon whether they are perceived as aiding staff or taking more time. One study found, for example, that radiophones save nurses an average of 30 minutes in each 12-hour shift, which may be appealing to overworked nurses. Technologies that add steps to an existing process, such as those that require a log-on or password to access materials, may be less accepted.

What new training needs result from the use of the new technologies? Training needs will vary depending upon the specific technology and the extent to which the worker will interface with the technology. Training housekeeping staff on how to call into a bed-tracking system for their next assignment may be relatively easy to do in an informal way, but training pharmacy staff on how to fill and program a courier robot or training storeroom clerks on how to enter all incoming supplies into an electronic system may require much more extensive training. Currently, adoption of these technologies is so uneven and exact procedures are so likely to vary by product that it is unlikely that facilities will be able to recruit new hires who have used the same system. This may change in the future as such technology products become widespread and standardized.

III. Methods

Visits were made to several New York City hospital facilities that were identified as leaders in health care technology to view the innovations in use and to talk to personnel about their experiences and training needs. A small number of telephone interviews were also conducted with information technology personnel at other New York City area hospitals to assess the prevalence of new technology in hospitals that are not known to be technological leaders. Finally, research staff participated in a technology conference sponsored by City University of New York about current and planned use of new technologies. The results presented below are centered around the questions asked and themes explored in this data-gathering process.

IV. Results

1. What types of new technology has your organization adopted in the past five years? How have you funded the technology?

The new technology adopted by hospitals varied dramatically across facilities. Some facilities did not have even a basic EMR system, while others had elaborate EMR systems that linked records from several systems (e.g., pharmacy, lab, imaging) into one central depository. The most technologically advanced facilities also had a variety of other technology systems -- automated labs, voice-activated records systems, bed-tracking systems, and courier robots -- but such facilities were the exception rather than the rule in the New York City area.

One way for facilities to adopt EMR systems was to "back in," that is, have one component of an electronic system (usually a billing system), and then retrofit other systems to "talk" to the foundation system. Many hospitals used "best of breed" criteria for choosing the various components that would be part of their system, and this often required significant retooling of the packages they chose in order to achieve interoperability with the rest of the system. Some hospitals indicated that these choices were made because they lacked the funding to build a system from the ground up, while others believed that it was more efficient in the long-run to choose the best component systems even if their integration into the larger network of systems required more effort in the short-term. At least one facility noted the importance of attending to the compatibility of components as a priority when selecting their technology.

Once EMR systems were established, hospitals faced the challenge of what to do with existing paper records. In some cases these paper records remained archived, but other hospitals were attempting to process some paper records into electronic format by scanning the images and archiving the images electronically.

Although one facility had a system that would eventually include their affiliated clinics, most facilities had no immediate plans to connect their system to outpatient providers in the community or to other hospitals outside their system. Most facilities that had achieved an EMR system, however, indicated awareness that this was the next step and spoke hopefully of the potential for community networks in the future.

Most facilities indicated awareness that technology, especially EMR, was something that would eventually affect them, but indicated that competing administrative priorities and funding constraints kept them from devoting serious attention to technology.

Within this scope, there appeared to be two types of facilities: those already implementing technology as part of an administrative master plan to increase profits and get a "competitive edge" by placing high priority and value around patient safety (i.e. a proactive approach), and those implementing technology only because of various external pressures beyond the facility's current needs or interests to do so (i.e. a reactive approach). Facilities

that demonstrated a proactive approach voiced the belief that the system would pay for itself by increased efficiency and by attracting new patients through a better quality of care, while facilities that demonstrated a reactive approach believed that technology systems would not necessarily be profitable, but would eventually become necessary for other reasons (e.g., legislative guidelines, payer requirements, and patient safety). Facilities that demonstrated a proactive approach were a clear minority, and generally had been recognized by external analysts as technology leaders in New York City and/or the nation.

2. Which health care professions typically use this technology in your organization?

Just as EMR systems varied between facilities in their degree of comprehensiveness and interoperability, systems varied substantially in terms of which workers would use the technology. In some facilities, the only workers to regularly use the systems would be physicians and medical records personnel. These most basic systems would continue to produce a great deal of paper because the single centralized electronic record was only one aspect of the patient record as a whole. Lab reports, patient charts, images, and other documents would continue to be filed as paper. In other facilities, virtually every patient care worker and some other workers (e.g., lab, pharmacy, imaging) would interact with the EMR system at least for minor tasks such as recording vital signs. Technology not directly related to EMR could involve an even broader array of staff (for example, bed-tracking systems that involve housekeeping staff and orderlies), but as noted earlier, such technologies were not in wide use.

3. How does this technology change the day-to-day job experiences of the workers in your organization?

The effect on day-to-day job experience varied by the type of worker. For nursing staff, for example, the use of an EMR system involved performing essentially the same basic functions only using a new tool. In contrast, some employees, such as medical records personnel, could find the very fabric of their jobs altered. Technology other than EMR could have dramatic effects on day-to-day job experiences, too. One hospital used an automated pharmacy where a robotic arm in a glass enclosure selected and packaged specified medications. Although the robot operated largely without intervention, it was occasionally necessary for pharmacy techs to enter the glass enclosure, where there was a potential for injury if the robotic arm were turned on. This clearly would not be a typical job concern for pharmacy techs operating in a traditional hospital pharmacy.

4. How does the technology affect your workforce (those who use it directly and those who don't use it)? Has it resulted in job loss, job creation or job redesign? Has the use of technology resulted in workforce reductions, additions?

Although the situation varied by facility, type of system, and type of worker, the overwhelming response was that jobs were neither lost nor created, but redesigned. The redesign could take place in one of two ways: either the workers who had currently been doing the job were retrained to perform the redesigned job, or these workers were retrained for another area of the hospital while new workers with different credentials were brought in

(perhaps from other areas of the hospital) to perform the redesigned job. In very few circumstances would hospitals acknowledge layoffs as a result of the technology, but sometimes they indicated that vacancies due to attrition would not be filled as a result of the technology.

5. Did the workers in your organization adapt easily to the technology, or was there initial resistance? Is the technology now completely accepted by your workers?

Generally, facilities reported that workers experienced initial trepidation about the new technology, but eventually acclimated to the new demands of their job. Workers were sometimes pleased by the opportunity to upgrade their skills, and in some cases facilities gave new job titles and somewhat higher salaries to workers performing the redesigned jobs, reflecting the greater skills the positions now involved. Workers in at least one hospital indicated that they felt empowered by the new systems, especially when they were given the opportunity for creative problem-solving and were allowed to help structure the system.

6. What barriers did you overcome in introducing the technology?

Barriers included those mentioned above: funding constraints, worker resistance, and interoperability issues.

7. What did you learn about introducing new technology that you think others could benefit from?

Several hospitals cited the critical importance of having the "right" trainers. Workers, particularly lower-level workers who may have limited exposure to computers in their personal lives, needed a great deal of support and assistance. Some facilities asserted that teaching workers "how to do it" was less critical than teaching them that they *can* do it. In one facility, training was done by staff members that were already known to many employees, and this previous relationship was viewed as an important factor in their successful training. Another facility had an external trainer who they credited with much of their success. Building relationships between trainers and trainees seemed to be critical.

8. Are there any drawbacks to adopting new technology?

All of the informants reported general satisfaction with their technology initiatives. Most complaints resulted from a desire to implement further technology without having the resources to do so.

9. How does this technology affect the training needs of workers in your organization? How is training provided? How is training paid for? Do you provide formal training opportunities for existing workers, do you rely on informal on-the-job training, or are workers responsible for obtaining their own training through other continuing education? If they turn to external sources for training, what kinds of sources do they turn to? Does your organization fully reimburse them for this training?

Training was almost always provided by the facility, either using internal personnel or through a contract with a vendor. This training was usually formal, and the length varied according to the personnel involved and the extent of their involvement with the system. Some facilities had core training for everyone when a system was implemented, and then held periodic trainings for new employees throughout the year. Others geared training to specific personnel initially, which made sense if some personnel would interact much more extensively with the system than others.

Sources of external funding for workforce training in technology were limited. The 1199 Hospital League Health Care Industry Planning and Placement Fund was one of the few external sources of funding cited by the facilities. The Fund also provides paid release time for employees to participate in training, which is a need that is not always recognized by others who fund training.

10. When you hire new staff, do you require that new employees are already comfortable with using the technology? Would you prefer to hire staff already comfortable/competent with using the technology if such recruits were more widely available? Should there be more training programs for students in the use of the new technology?

No facility looked for staff with specific knowledge of their systems, although most facilities indicated that they would prefer to hire staff with basic computer literacy if available. Part of the problem with requiring staff to be already comfortable using the technology is that most widespread technology, like EMR, is available in various packages. One informant remarked that, "If you've seen one EMR system, you've seen one EMR system." Nonetheless, some facilities indicated that experience with any EMR system would give applicants an edge over someone who had never used any EMR system, just as some familiarity with computers was better than none. Facilities generally seemed to accept that they would have to provide any technology-related training, although some indicated a desire that more educational programs such as nursing programs would expose students to at least some variety of EMR programs.

V. Conclusions

- Technology adoption in New York City hospitals is currently very uneven, with some health care providers taking the lead and others doing very little.
- Funding is a large issue – both funding the purchase and set-up of the product and funding the training for the staff.
- Interoperability (the ability of systems to interface with one another electronically) is a serious issue both within and between facilities, and can limit the potential of electronic systems and make the recruitment of workers with the requisite skills more difficult.
- Technology products and systems vary widely by vendor, and expecting new hires to be trained to a specific system often is not realistic. Most training is vendor-driven, and often is done by vendors or by facility personnel.
- There will be increasing demand for basic computer literacy for the growing number of health care technology end-users.
- Demand for support people, such as medical informatics and information technology professionals, is expected to grow.
- Exposure to and use of technology should be integrated into the curricula of education programs for all health professionals.
- There are gaps between the skills health workers will need as use of technology in health care increases and their current skills.

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