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CHAPTER 5

Indoor Positioning and Digital Management

Emerging Surveillance Regimes in Hospitals

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Not all surveillance is intended as such. In spite of intentions, the valence of some technological systems toward surveillance should not be underestimated. Within the domain of health care, there has been an increased emphasis on the use of information and communication technologies to streamline processes by centralizing patients' records, locating medical equipment, and tracking hospital staff and patients. Although these changes are often couched in terms of improving patient care, the direct benefits to patients are often considered too "soft" to measure compared to a "hard" economic outcome like hospitals' return on investment. What is rarely mentioned—and then only in the most guarded terms—is the tendency of these technologies to function as surveillance systems that monitor the activities of patients and staff, particularly nurses.

In this essay, I examine the emergence of radio frequency identification (RFID) as one such technology within hospital settings. First, I describe the technology and its applications outside of and within health care. Next, I examine the implications of RFID technological systems on existing hospital infrastructures, paying particular attention to their effects on existing divisions of labor. Finally, to highlight the politics of surveillance, I analyze the intersection between discourses of "indoor positioning" and

"workflow management." The argument here is that the deployment of these technological systems is reflective of broader trends in managerial cultures. As such, the operations of power within these systems must be examined both as local and specific and as global and contingent.

A Technological "Solution" Looking for a Health Care Problem?

Although RFID technologies have historically been associated with military uses (Landt and Catlin 2001), they have thrived within manufacturing and distribution industries. RFIDs are classified as "automatic identification" technologies that are used primarily for "data capture." What this means is that once equipped with RFID systems, items that are tagged with RFIDs can be counted, tracked, and processed as they pass by an RFID reader (also called "interrogators" or "scanners"). These systems are considered far superior to their predecessors like barcodes or manual methods of collecting data because they are not optically read (Zhekun, Gadh, and Prabhu 2004). For example, barcodes require a direct line of sight, so that the reader must be placed directly against or near the barcode. Although this is an effective technology, it is considered especially vulnerable to conditions: barcodes can become dirty, tear, and fail to work. In contrast, RFID tags can be read regardless of most conditions because they can be read without a direct line of sight as long as they pass through or near a reader. In industries such as manufacturing and distribution, the development of low-cost RFID technologies often referred to as "smart labels" are said to increase knowledge within supply-chain management (Brewer, Sloan, and Landers 1999; d'Hont 2002).[1]

The economics of this technology explain its recent surge in sales and the interest of manufacturers, distributors, and retailers to implement RFID systems. What is special about RFID for those wishing to maximize its value is the facility with which it fits within global systems of production and consumption. Given the emphasis on flexibility within discourses and regimes of economic globalization, RFID technologies enable post-Fordist forms of production, most notably just-in-time manufacturing because distribution and retail companies are better able to monitor their inventories as they flow across borders and spaces. Moreover, these technological systems promise to bring the flexibility of production to the retailers. Through the development of RFID systems to track not only the number of products in retailers' inventories but also the number of those products on the shelves, the goal becomes the creation of just-in-time retail environments to complement and work in conjunction with just-in-time production (E. Hess 2003).

Although most advanced levels of retail uses of RFID systems have not yet been actualized, Wal-Mart has become a leader in promoting RFID implementation from manufacturing to product sales. In a move to increase the use of this technology, Wal-Mart required their top 100 suppliers to tag all case and pallet shipments with RFID. This mandate went into effect in January 2005, and its goal for Wal-Mart was to improve distribution of products to the retail stores from their own warehouses. According to early studies of the efficacy of these systems, Wal-Mart reports that stores are better able to keep products in stock and on the shelves and to speed up the process of replenishing out-of-stock items (Malone 2005). In spite of Wal-Mart's support for RFID, few other retailers have similarly begun making demands of suppliers to tag their shipments.

What is interesting is that retailers experience more financial savings and gains through the deployment of RFID than do manufacturers. As a result, without the pressure of their retailers, many manufacturers have not begun integrating RFID to the extent that had been projected. According to one industry analyst, the RFID industry "continues to over-promise and under-deliver," reporting that the developments in RFID technology have been slower than promised, the supply of existing technology has not caught up with the demand, and the cost of the tags has remained high (Roberti 2005). In other words, the demand by retailers like Wal-Mart for suppliers to use RFID passes on the cost of implementation while retailers benefit from the cost saving that comes with these systems. The case of Wal-Mart, and its positive experiences with RFID, is important because it has led to increased publicity for these systems over the past few years (Murphy 2003). Given the perceived benefits of the use of RFID in retail, the technology companies and other industries began to speculate about the transformative value RFID systems could have for organizations ranging from education to health care (Stanford 2003).

Within health care in particular, the impetus for integrating RFID systems into hospitals has been enabled further by federally mandated initiatives. In April 2004, President Bush issued an executive order calling for the incorporation of health information technology into all medical practices nationwide and the creation of a National Health Information Technology Coordinator to oversee the process.[2] In May 2005, the U.S. Department of Health and Human Services issued a complementary report calling for government partnerships with private technology companies to accelerate the process of developing health information technologies (Lewin Group 2005). These policy positions are representative of a larger, ongoing shift toward information technology systems in public, private, and nonprofit sectors (Monahan 2005a).

The transition of RFID systems from manufacturing to health care has not been as seamless as hospitals and technology companies had hoped. The implementation of these systems is seen as a potential solution for the clinical problems that many hospitals are facing, yet critics wonder if RFIDs are solutions looking for a problem (Greene 2004, hospital representative, personal communication). On one hand, these systems do not adapt easily to hospital settings because the infrastructure of hospitals—in terms of space, equipment, personnel, and patients—is much more complicated than factory or warehouse settings (Ostbye et al. 2003). On the other hand, these systems promise to decrease the operating expenses of already cash-strapped hospitals by increasing workflow and asset management (Calvaneso 1999). Although RFID has the potential to provide a robust return on investment for hospitals, what is much less clear, however, is how well these technologies can improve health care delivery, particularly without creating new burdens on overworked clinical staff.

As for their actual uses within hospitals, RFID systems allow for the electronic tagging of hospital assets, inventory, personnel, and patients. Essentially, the RFID systems work by placing unique electronic identifiers on *items* (in the form of stickers embedded with RFID chips) or on *people* (in the form of bracelets or badges embedded with RFID chips). Once "tagged," items and people can be identified, tracked, and managed through a centralized database. Many hospitals have begun to adopt RFID systems with the goal of locating pieces of equipment when medical staff needs them. This serves two stated purposes. First, medical staff, especially nurses, can spend less time "hunting and gathering" equipment that they need and spend more time providing direct patient care (McCarthy 2004). Second, hospitals can more efficiently utilize the equipment they have and lower expenses on equipment rental and purchasing (Glabman 2004).

Other hospitals have begun to adopt RFIDs for patient and personnel identification and location purposes (U.S. Medicine Institute for Health Studies 2004). For example, RFIDs have been embedded in patient bracelets so that medical staff can electronically identify patients before surgery and before administering medications and blood transfusions. In addition, these systems have been implemented to locate where patients are and to collect data on patients' movements through hospital services. Similarly, medical staff members have been given RFID tags on badges to collect data on workflow to find inefficiencies in current hospital operations. These latter types of systems have primarily been implemented in emergency departments and surgical centers, places where there are large volumes of patients and heightened risks of medical error.

Thus, RFID systems are thought to offer great promise for increased efficiency and cost savings in hospital settings, but little empirical evidence

exists on what the implications of these systems are on existing infrastructures, including staff practices and procedures. Existing literature on hospital uses of RFIDs touts the potential for heightened patient safety (Neil 2005; Jossi 2004), better tracking of drug supplies (Young 2004), and real-time management of hospital assets (S. Davis 2004; C. Becker 2004). Other studies of medical RFIDs highlight the complexity of integrating multiple technical systems when so few of them possess interoperable capabilities (Perrin and Simpson 2004)—this is in part due to the proprietary nature of most information technologies. A larger constraint placed on hospitals is the lack of financial resources and technical staff necessary to implement even basic health information technologies to meet the requirements of federal regulations, let alone more specialized RFID systems (Office of Inspector General 2003).

Implications of RFID Systems for Health Care Workers

In an era of information management and audit culture (Strathern 2000), RFID is a valuable information technology because of its ability to collect data in real time. Its application within hospitals can be understood within the domain of "workflow management" and the attempt to make hospital processes more efficient (U.S. Medicine Institute for Health Studies 2004). Given this particular mode of use, it is important to understand the organizational and social effects of this technology on health care workers. This section describes specific RFID implementation projects to highlight the effects of these systems on hospital employees.

The data that follow were collected in the summer of 2005 and constitute part of a pilot study on the implementation of RFID systems in hospitals. The methods for this initial project consisted of participant-observation at an industry conference that largely served to sell RFID systems to the hospital administrations and representatives who attended. I also identified the major RFID hardware and software companies that were directly marketing their products to hospitals. This involved speaking to representatives at the industry conference, conducting informal phone interviews, and reading through materials on companies' websites (particularly press releases). In addition, I conducted several informal interviews with representatives of hospitals that I identified from the Internet as having installed or being in the process of installing RFID systems. Although this preliminary project was not highly systematic, it provided a good sense of the ways in which the technology companies and hospitals viewed this emerging technology. I do not name the hospitals I describe, and although many of these organizations can be identified fairly easily on the Internet, I want

to draw the reader's attention to trends for RFID use in hospitals rather than to which hospitals are using the technology and for what purpose.

At the end of 2004, a large university hospital deployed a partial RFID system to track equipment within their surgery department, consisting of more than thirty operating rooms, pre- and postoperative care units, and equipment storage rooms. According to a Radianse press release, the installation of what this technology company has dubbed its "indoor positioning system" at the hospital was meant "to help staff prepare for procedures by providing the real-time location of necessary medical equipment, devices and accessories. The use of a Radianse [indoor positioning system] is expected to save time and increase clinician satisfaction and productivity while reducing asset shrinkage and the need for excess rentals or repurchases" (Radianse 2005).

From the hospital administrators' point of view, an RFID system was an attractive solution to cutting down costs associated with hospital equipment by being better able to use a smaller number of medical tools and machines. RFID technology companies describe one problem that has been identified with equipment as "hoarding" by nurses of items that they frequently use (Reid 2004). In this view of hospital function, a small number of nurses stockpile equipment so that they know where those items are when they need them, and this results in other nurses (and—in the narratives—not infrequently doctors) being unable to find the items they need when they need them. The administrators anticipated not only that this system would have an economic benefit for the hospital, but also that the system would increase nurse satisfaction because they would spend less time looking for equipment.

After installation, the technology worked just as Radianse had promised. The software identified the location of the equipment that had been tagged with RFIDs within the areas of the hospital equipped with readers. Yet in spite of the success of the technological elements of the system, the hospital could hardly declare the implementation of the system an unqualified success. What the administrators had not anticipated was the huge resistance to the RFID system on the part of the nursing staff. Rather than giving the expected response of gratitude, the nurses directly sabotaged the system by removing and often destroying the RFID tags attached to equipment. Moreover, the hospital had not envisioned a process for how the technology would be used. For instance, it was unclear whose responsibility retrieving equipment should be, and it was even more ambiguous who should be part of the support staff to ensure tags are replaced, missing equipment is investigated, and reports are written. The problems with the system were based not on the efficacy of the technology but on the material infrastructure and receptivity of personnel.

According to a hospital representative (personal communication) who was quite frank about the mistakes that the hospital has made with the installation and use of the RFID system, the root of their problems stemmed from the hospital's desire to have the newest, most advanced technology. The technological imperative in information management preceded careful thought about the goals, necessary infrastructure, and staff acceptance of the technology. As a result, there were widespread misunderstandings about the technology and what types of data it was collecting. Many of the nurses referred to the system as "big brother." To disabuse nurses of the notion that the RFIDs were minicameras, the administration scheduled what it perceived as an overdue training course to educate nurses about the technology and its function within the hospital.

In spite of the administration's attempt to quell nurses' resistance to the system, the training session did little to change their reception of the technology. The information about the RFIDs may have mitigated their suspicion of the system, but it resulted in the nurses' perceiving the technology as "offensive" (personal communication). Even though its capacity to surveil individuals is not as direct as many of the nurses had at first imagined, the system has a disciplinary valence for nurses. Because the equipment is being tracked and monitored by the RFID system, nurses could no longer claim equipment as their own, even if this previous system worked better for them than the indoor positioning system. The RFID technology has the effect of surveilling the practices of nurses in the aggregate even if individuals cannot be specifically identified. The nurses' resistance to this technological system can be understood in terms of the work intensification that seemed to accompany its implementation. Within the context of understaffed hospitals and overworked nurses, the assumption by many nurses was that the RFID system might increase their workload and that it could not reduce their work burden in any significant way.

Examining the technology within its use context, it becomes apparent that the technological system is ultimately more about the people using the medical equipment than it is about the items being tracked by RFID. The problem is not that equipment disappears of its own accord but that those using it are perceived as not sharing it effectively. This framing applies equally to nurses who are intentionally hoarding equipment as it does to the more common occurrence of equipment being left in the last place that it is used (and therefore making it difficult for staff to know where that use took place). From the administration's economic perspective, the installation of the system was seen as a better alternative than outfitting each room with all the necessary medical equipment. This was the case because the goal was not so much about making sure the equipment was readily available when needed but rather to save money by identifying the

minimum number of each piece of equipment that was necessary for the hospital to run efficiently.

If RFID systems that track equipment have disciplinary effects on people, what then are the effects of RFID systems that track the people themselves? When RFID is used to locate people within hospitals, it can be used to different effects depending on whether it is patients or personnel, or both, who are tagged and to what extent the hospital is equipped with scanners to locate those individuals. These systems range from universal coverage at hospitals to the monitoring of relatively small areas such as emergency rooms or surgical wards. The next examples serve to illustrate some of the implications of indoor positioning with the purpose of tracking people.

When patients are tagged with RFID, it is often so that individuals do not get "lost" within the hospital or incorrectly identified during medical procedures. The technology can be embedded innocuously in hospital identification bracelets or can be a more complex plastic badge that has buttons that are programmable by the hospital for various functions and then worn by patients. It can now even be implanted in patients' bodies.[3] Part of the logic of using indoor positioning to track patients is to know where they are at any given moment and often to know how long they spent waiting in various hospital departments. Several large urban hospitals that implemented this type of system explained that before its installation, patients would be "lost" because of communication breakdowns between units. As an example, a patient may be taken to radiology, but the floor nurses may not be informed. Similarly, patients can get "stuck" in departments when they are caught between shifts, and no one knows to return them to their rooms. Other hospitals have mobilized RFID to verify the identity of patients before dispensing medications, conducting blood transfusions, and performing surgery. This latter function of linking the identity of the individual to the RFID tag is particularly concerned with reducing the number of medical errors that occur within hospitals.

In a different type of tagging patients with RFIDs, one large urban hospital has implemented the technology not to identify individual patients per se but to streamline hospital processes. For example, the administrators at this hospital argued that nurses were not notifying housekeeping as soon as patients were discharged to prepare the rooms and beds for newly admitted patients. From the perspective of nurses, this is often seen as a strategy to have a temporarily lighter patient load in their overburdened schedule (due to a nursing shortage and understaffing at hospitals). From the perspective of administrators, this delay costs the hospital money because the beds are empty. An RFID tag embedded within the patient identification bracelet was programmed to send a message to housekeeping when the

bracelet was cut at discharge. In this case, the technology was designed to circumvent nurses altogether in the process of preparing rooms for new patients. The hospital reported, however, that nurses responded by "forgetting" to cut the bracelets (either by sending patients home wearing them or even by slipping them off patients' wrists intact).

In another example of using RFID to streamline hospital procedures, a large rural hospital implemented the technology in its surgical department. The hospital was interested in using RFID to collect data about its current practices to understand how and why bottlenecks occur and to build solutions from its own data to establish (and evaluate) better practices. To do so, the hospital implemented a full indoor positioning system to track equipment and people. Patients, nurses, and physicians are tracked within the system by the RFID badges they wear. More than using RFID as just a positioning system, however, this hospital uses it to capture time data for its complementary software system. By measuring how long patients are in particular locations in the surgical department, how long specific elements of procedures take, and which personnel are present at each stage of the process from registration to discharge, the hospital aims to make all of these processes more efficient for both the staff and the patients. Other features of the system include an electronic white board with real-time information about the status of each patient and a waiting room terminal from which people waiting for patients in surgery can receive information about their progress.

Unlike the staffs in most other hospitals, the primary advocate of the RFID system at this hospital was an administrator with a background in nursing. This led to several unique features of the system. First, the staff members in the surgical department were included in the design and implementation of the system so that it would be better suited to its users and more sensitive to the specific functions of their hospital and their unit in particular.[4] In addition, the staff members' RFID badges were programmed with a privacy button, so that they could opt to be "invisible" within the system if and when they so desired. One of the rationales for this was to make staff breaks more formal within the system (particularly because of the system's data collecting function) and to give staff members a sense of control over the technology's surveillance of their activities. Finally, as a result of her experience as a nurse, this administrator recognized that one of the most common delays in the operating room is due to physicians' absence or tardiness. She observed that physicians can "disappear" in various parts of the hospital, and surgeries are often delayed as a result. From her perspective, the benefits of the indoor positioning system far outweighed the pager system that they had previously relied on. When the exact location of physicians can be pinpointed through RFID

and their time to respond can be measured, she argued, physicians have more incentive to show up to the operating rooms on time or more quickly after a page.

In these examples of RFID systems implemented in hospital settings, it is unclear if the technology is providing a solution to health care problems. On one hand, it can be said that RFID does indeed offer a technological fix, as in the example of equipment tracking. In these cases, hospitals have limited budgets and limited equipment, and indoor positioning can potentially aid in the efficiency of use of scarce resources within busy departments. On the other hand, however, the more complex indoor positioning systems that are tracking the movements and activities of people, whether patients or staff, do not seem to be addressing any particular problem that would be identified by hospital personnel or patients. Instead, these systems are creating modes of digital management to collect increasingly specific data on hospital practices and to increase the accountability of personnel. In other words, the technological systems are predisposed to disciplinary or social control uses within these specific settings.

Depoliticization of Surveillance

In their own understanding of the data being produced through indoor positioning systems, hospital and technology company representatives describe the results as "workflow management." I understand the term *workflow management* to be reflective of the insertion of new modes of scientific management or neo-Taylorism into the governing rationale of organizations. Rather than focusing on the broader organization of work, workflow management tends to individualize processes by looking for inefficiencies that are created through staff practices. The management goal becomes the creation of standard operating procedures and best practices that personnel, particularly nurses and support staff in hospitals, are compelled to follow.

Any mention of surveillance is deflected by discussions about the stated purpose of these systems, which is to create more efficient processes, not to monitor individuals within the systems. In a rhetorical move, surveillance fears are discounted because they are associated with individuals, not groups. Within this technological discourse, surveillance is positioned as irrelevant within the stated aim of organizational change. By reframing the actions of participants within the system as "data," the tracking of those actions is artificially delinked from the politically charged realm of surveillance and the contextually complicated social and material spaces of hospitals. Moreover, it should be noted that surveillance is further discounted in these settings because the systems are not visual systems

employing optical modes of supervision or examination (and they are only rarely linked to closed-circuit TV security systems). Because the politics of surveillance are so intimately linked with visibility, indoor positioning systems can be presented as "simply" ubiquitous, disembodied radio waves that are somehow separate from the human actions they are capturing.

The distinction between and separation of workflow management and surveillance is dangerous because it has the potential to leave the individuals within the system exposed to exploitation and abuse. When they are told that they are not being watched or that the individual-level data does not matter, the importance of the implications of group-level surveillance is undermined, whether those groups are constituted by patients, doctors, nurses, or other hospital personnel. The data collected and the systems themselves have real implications for the policies and decisions that will be made regarding those groups or the broader organization. The effects can range from changes in how work is distributed, how accountability for mistakes is determined, and how budgets should be allocated. Surveillance is about control; if the RFID systems can monitor groups or flows to regulate practices, then social control and thus surveillance are occurring.

Although RFID and indoor position systems may indeed prove invaluable in health care settings such as hospitals, it is important to understand the politics of the technologies and anticipate the types of outcomes that are produced as a result. RFID may indeed be found to have an extraordinary ability to reduce medical errors. When the goals and aims of health care are not clearly defined in the development and implementation of the technology, however, the capabilities—and hence the valence—of the technology have precedence in defining the form and function of the systems. The technology is underdetermined and shapes itself to the existing institutional inequalities within particular hospitals and health care systems more generally. Denying the surveillance functions and potentials of these systems may artificially depoliticize them, but it does not make the participants any less observed or controlled.

Notes

1. It is important to mention that there are different types of RFID technology. There are two primary types: active and passive. The difference between the two is whether the RFID has its own battery source. Active RFIDs have a miniature battery that enables them to actively emit radio frequencies to the system, whereas passive RFIDs do not have their own source of power and must be activated through the use of "reader" devices (U.S. Department of Commerce 2005; Monahan 2006).
2. Presidential Executive Order 13335 (Bush 2004).
3. An implantable RFID chip was approved by the U.S. Food and Drug Administration for human use in October 2004. As of this writing, it is currently being used in two large hospitals in the United States and in several hospitals in other parts of the world. According to a press release in December 2005 by the technology company VeriChip, the company

has agreements from 65 other medical facilities to begin implanting chips in patients in the near future. The idea behind an RFID implant is that patients can carry their medical records (or, more accurately, an identifier to access their records) with them wherever they go.

4. This type of involvement of the end users can be considered "participatory design."