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Implementation of OpChart in West Medical Building

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"The system is locking up again! Are you kidding me? I swear this program hates me." Walter Sellers glanced over at the patient, who lay on the operating table. The patient was a 12-year-old boy who was being operated on to repair an inguinal hernia. This procedure is generally minor in scope, but any task can become difficult when the tools impede, rather than facilitate, one's ability to work. The pediatric surgeon glanced over to see Walter with his full attention on the unruly computer and his back turned to the patient. This prompted a swift rebuke. "Hey! You need to be doing your job here—you've got an airway to manage!" "Yes sir, I apologize." Walter turned back to attend to the patient's endotracheal tube. He needed both hands free to secure the patient's airway, and yet he also needed both hands available to force the computer into submission. It was indeed frustrating to him, to feel the hot temper of the surgeon directed at him when it was not his fault that the computer would not function properly. "You know, you really should scrap that newfangled computer and just do your charting on paper, like we always have," the surgeon suggested. With a sigh of relief, Walter reached for some paper and said, "That sounds good to me. . . ."

Introduction

This case study describes the implementation of an anesthesia informatics system in a surgical unit at Riverview University Medical Center (RUMC). This tool is one part of a larger perioperative informatics initiative that includes many computer-based modules. All these systems were developed locally with direct involvement by practicing anesthesia staff and are in daily use across the varied surgical units of this large medical center. Developers and users attest that these products have been readily adopted into the clinical practice of anesthesiology and are happily used in the various operating suites within the hospital—with one notable exception. The module of interest to this case study, called OpChart, allows for electronic documentation of patient information during an operation. In the one surgical area where the majority of pediatric and ophthalmologic surgeries are performed, OpChart has not been successfully adopted. In fact, an attempt was made to implement it in these operating rooms 3 years prior to the date of this case study. This effort resulted in widespread rejection of the system in these areas, conflict within the anesthesiology department, and a general feeling of resentment and mistrust toward the OpChart system. These sentiments persist to this day. However, with the advent of the Health Insurance Portability and Accountability Act (HIPAA), the need for electronic documentation during surgery is

now greater than ever, so a fresh attempt at deploying OpChart in this unit of nine operating rooms has been planned. In this case study, the authors explore the unique features of this surgical unit, attempt to uncover the causes of the failed implementation in the past, and evaluate the barriers that must be overcome for successful implementation of the OpChart system.

Background

RUMC is an academic, nonprofit tertiary care center in an urban setting. Located in the Midwest, this health center is comprised of an adult and a pediatric hospital with more than 650 patient beds and an annual volume of about 31,000 admissions. RUMC offers multidisciplinary surgical services that include general, pediatric, cardiothoracic, ophthalmology, trauma, neurosurgery, transplant, and others. There are six distinct surgical units with thirty-nine operative rooms in total. RUMC operates with a surgical case volume of approximately 1,600 cases per month. These include inpatient and elective outpatient operations, as well as emergently required procedures. Operating rooms are available for use at all times thanks to surgical and anesthesia personnel who are on call 24 hours a day, 7 days a week.

The Department of Anesthesiology is responsible for all perioperative patient care and is comprised of a staff that includes fifty attending anesthesiologists, forty resident physician trainees, thirty-five certified registered nurse anesthetists (CRNAs), and fifty-two student registered nurse anesthetists (SRNAs). Perioperative patient care encompasses all aspects of patient management from preoperative assessments until the patient is considered stable in the recovery room after surgery. Clinical responsibilities include a medical preoperative risk evaluation, insertion of any necessary vascular lines, the induction of anesthesia and airway management including intubation, monitoring of patient vital signs during the operation, and transfer of the patient to the recovery room area where a final clinical assessment takes place. First-line patient care and monitoring are performed by either an anesthesia resident physician or a CRNA. All patient care is supervised by an attending physician who is board-certified in anesthesiology and who may oversee multiple ongoing cases at one time.

The Department of Anesthesiology uses a suite of medical informatics tools developed locally by the perioperative informatics group. This set of tools, is known as the Riverview Perioperative Computerized Management Suite (RPCMS). The development group gives the following description of their software.

> RPCMS was developed . . . to bring electronic charting to surgical patient care. The system is designed to be a complete solution providing documentation and management tools for all care providers (nurses, surgeons, anesthesiologists) throughout the entire care process from the initial visit in the surgical clinic through all phases of operative care. In addition to providing for electronic documentation and information sharing, the system was developed to support billing, quality improvement, cost containment, and clinical research efforts.

RPCMS began development in 1995 with implementation of the preoperative module. The outcomes module, which documents postoperative care and supports quality improvement efforts, began clinical implementation next. The anesthesiology intraoperative charting component of the intraoperative module, OpChart, was rolled out in 1996. The patient tracking product was implemented in early 1997 and has received several additions/modifications, achieving its current form in early 1999.

RPCMS makes the life of the user easier. The operating room (OR) schedule, patient anesthesia evaluations, and all past intraoperative reports are available over the Inter-

net. In addition, special equipment needed for the next day (fiberoptic bronchoscopes, rapid infusers, etc.) can be reserved online. User case logs are available along with vacation schedules, lecture schedules, and other useful information.

The informatics development group for anesthesia is led by Phillip Knowles, who is the director of the perioperative informatics group. Although he holds a joint appointment in the Department of Anesthesiology, his primary position is within the informatics center at large. Knowles holds a masters in biomedical engineering. He built the perioperative informatics group and is the principal developer of all the anesthesiology informatics initiatives. As the technical project leader, there are a number of programmers assigned to the projects who report directly to him. These include three current developers, as well as two more who have been hired but have not yet begun working with the group. In addition, one programmer is serving in active military duty. Knowles has the latitude to determine the priority of small projects and to assign specific tasks to the programmers. The group is physically located within the same office space as the Department of Anesthesiology.

Two committees direct the efforts of this development group. The first is the perioperative executive steering committee. Its responsibilities include overseeing the perioperative informatics group as a whole and prioritizing its future development efforts. Its members control the RPCMS development budget, which includes funding for hardware and software development personnel. The steering committee is also responsible for coordinating the integration of the perioperative informatics group within the overall informatics goals of the entire medical center. Its members consist of administration-level faculty in the anesthesiology department, including Phillip Knowles. Another member is Raymond Bryce, M.D. Bryce is an associate professor and the clinical vice-chairman of anesthesiology, as well as the medical director of perioperative services. Also on this committee is Doug McPeak, M.D. Trained in pediatric anesthesiology, he is an assistant professor of anesthesiology as well as the associate director of anesthesia informatics. Second, there is an operations committee to handle the RPCMS day-to-day operating issues.

OpChart Product Description

The OpChart software tool represents the intraoperative anesthesia management component of the RPCMS toolset. What was the most important rationale for the creation of this system? The answer to this question varies depending on who is asked. According to the developer, the primary motive was not electronic documentation but rather to improve the outcomes analysis of surgical procedures at the local institution. The goals of such an analysis included minimizing bad outcomes and maximizing good outcomes, decreasing patient length of stay, and demonstrating trends of improvement. A secondary goal was to facilitate automatic data collection for research purposes, creating a master clinical data repository. A number of publications have already resulted from this collected data. Additionally, having clinical data consolidated into a central database allows a degree of information availability not possible with a paper chart, whereby only a single, easily misplaced, copy of a chart exists. John Eaves is a CRNA who worked at RUMC during the time of OpChart development. According to him, the impetus for change was to cut down on paper storage, to enhance access to old patient charts, and to create an easily accessible database. Similarly, Sarah Koehler, also a CRNA, suggested that the drive to move to computerized record keeping mainly involved the desire to eliminate paper trails, to capture charges in a

punctual fashion, and to allow easier access to lab results and other relevant patient information.

During a surgical case, OpChart use begins when the patient is brought into the OR. A new case can be opened using either a blank document or a premade template. Basic information about the case is maintained, such as the start time. Real-time charting of vital signs then begins, and the user updates the values for heart rate, blood pressure, temperature, respiratory rate, and oxygen saturation every 5 minutes for the duration of the procedure. All information about anesthesia administration is logged into the system, including drugs given, doses, and routes of administration. Any intravenous fluids or drug infusions given can also be added to the case information. Information about airway management is also entered. The user may elect to monitor certain values as the operation progresses, such as hematological parameters or other laboratory values of interest. Special dialogs are available where the user can enter information pertinent to any abnormal or emergent events that arise, or any unexpected delays that are encountered. Last, the electronic charting is completed in the recovery room. At this stage, a final vital signs entry is recorded, a postoperative assessment is performed, postoperative orders are entered into the system, and the chart is closed.

Development of the OpChart system was begun in 1996, and its first clinical deployment occurred at the Riverview Clinic (TRC) as a pilot site in 1997. From there, it was also deployed in an orthopedic outpatient surgery unit, in West Medical Building (WMB), in gynecological ORs, and in the main Riverview University Hospital (RUH) operating suites. All these implementations went smoothly with the exception of the one in WMB, which will be described later in detail. Of note, the system has also been successfully deployed at a private nonteaching hospital in Fairview, located about 1 hour from RUMC. The system is presently being used in twenty-eight operating rooms at the local institution, not including the operating rooms located in WMB. The intended users of the system include attending physicians in anesthesiology, resident physicians, CRNAs, and SRNAs. The decision of whether to use OpChart for any given case is made by the attending physician at the time when the patient is brought into the OR. During the course of a case, the primary end user of the system is generally a resident or a CRNA. Only one individual can use the system at a given time for each case, but the designated user can change during the course of longer operations, with a maximum of three users associated with any particular case.

As the system was being implemented, users were trained in the OpChart system through in-service instruction consisting of group classes. Some test patient files and real charts from old cases are available to these users for training purposes. End user feedback is obtained through a forum, open to all RUMC users of OpChart, which typically meets once or twice a month. The frequency of these meetings is adjusted according to user attendance, and some time periods passed without forum meetings because of low attendance. The official front line of support for the OpChart system comes from the local medical center help line. The help line is a general user support desk that services all clinical informatics applications. This center therefore serves as a general relay center for messages regarding issues with the system. According to the help line, any computing problem that interferes with the ability of a clinician to deliver patient care is labeled a "critical problem," and consequently calls from OpChart users who have an ongoing case are given the highest priority. From the help line, a request for help can be relayed to an on-call anesthesia support person, although passing along the issue like this causes a concomitant delay. As backup, a system analyst or programmer is also on call and can be contacted for support. It should be noted, however, that most users prefer to obtain informal technical support from other end users, par-

ticularly those who are most savvy with technology. In fact, while the authors were interviewing Charles Bertram, a CRNA "superuser" of OpChart, he fielded a phone call from another system user who needed assistance. Moreover, Bertram assembled the only comprehensive documentation for OpChart, in the form of a user guide that was released in January 2003. He undertook this documentation project under his own initiative.

The overall user sentiment toward the software is positive from the staff members who work in the adult operating suites. Resident physicians obtain the most varied exposure to OpChart since they rotate through different surgical services and experience it in a variety of environments. As a result, they are reportedly comfortable with the system and do not have problems using it in these different areas. One resident interviewed in the outpatient surgical area stated that he liked the system because of the ease of transfer between users in the middle of an operation. He also noted that it eliminates the need for the interpretation of handwriting, which is sometimes ambiguous and may lead to medical errors. Charles Bertram reported that he likes the system because he can pull a record from prior surgeries for a given patient, check the status of the airway in those cases, and see how it was managed. When he finishes an operation and closes the chart, he is satisfied knowing that the charting is "100 percent complete." A few users have complained about specific aspects of the system. For example, it cannot interface with the monitors that display vital signs, so the user must read the monitors and enter this data into the system manually. Also, some of the available templates are a bit limited because the template does not include intravenous drips, drug selection is limited, and there is no option to customize which vital signs will be monitored. One particularly common complaint is that the system is slow and unresponsive when it is querying the central server for information. This slowdown can lead to a great deal of waiting when the system is overloaded, and delays in the OR can cause frustration for the entire team.

WMB and the Initial OpChart Implementation

The focus of this case study is the implementation of OpChart into an operating suite consisting of nine rooms located in WMB, a building adjacent to the main hospital. The case load for this area includes most pediatric surgical cases, including pediatric subspecialty cases such as orthopedics and ear, nose, and throat. Adult ophthalmology operations are also performed at this location. The only pediatric cases not performed in WMB are pediatric cardiothoracic procedures, which are done in the main RUMC operating suite. Six rooms are designated for pediatrics, two rooms are reserved for ophthalmology, and the remaining room is used for either type of operation. The WMB operating suite has its own dedicated preoperative rooms and postoperative recovery areas. Procedures are scheduled Monday through Friday from 7:00 A.M. through approximately 4:00 P.M. to 5:00 P.M. The anesthesia staff who work in WMB are specially trained for pediatric care, and the vast majority of them work only at this location and do not rotate through any other surgical areas of the hospital. The notable exceptions to this are the anesthesia residents, who rotate monthly among all the surgical areas.

Each surgical suite within the medical center is unique, having its own clinical focus, management style, and local culture. The operating suites in WMB are perhaps even more unique than most. Anesthesia department members at large and the individual staff who work there have expressed a number of ways in which they differ from other

surgical locations. First, the primary clinical focus in WMB is on pediatric patients. Operations performed on children require that closer attention be paid to the patient, and as a consequence, less time can be spent on other things such as electronic documentation. Significant attention must be paid to airway management, as pediatric cases generally use uncuffed endotracheal tubes which are more prone to becoming dislodged during an operation. Second, in WMB, cases take less time on average to complete. This means there are more operations being performed in each room per day and that efficient, rapid turnaround time between cases in an OR is essential. This turnover rate is dependent on many factors, and the speed with which the anesthesia staff can finish charting one case and begin charting the next may be, but ought not to be, a rate-limiting factor.

Finally, there appears to be a different culture in the work styles of the pediatric specialists. Many of the attending anesthesiologists are very opinionated and particular about how charting should be done. As previously mentioned, OpChart allows for customized user templates which serve as a basis for clinical documentation. It has been observed that some anesthesiologists in WMB have strong feelings about not using the same templates used in other areas. For example, some request that no information about emergency situations be included in the templates and that the airway management details be documented without the use of a premade template. Despite these differences, there are important aspects of the care delivered in WMB that are shared by other locales. As previously mentioned, pediatric cardiothoracic surgery is performed in the main hospital OR, and OpChart is used for documentation in all these cases.

In 2000, the majority of the operating rooms at RUMC were using OpChart for their intraoperative documentation. Because the operating suite in WMB was already using some of the RPCMS applications to perform preoperative and postoperative assessments, this location was next on the implementation schedule for OpChart. The first step of the implementation involved the installation of hardware in each of the nine operating rooms. Some users attended an informal 1-hour "in-service" training session led by Dr. McPeak, the clinical lead for the project, as a means of introduction to the system. However, there was no mandate at this point that the system be used during operations, nor were there any official training classes or dedicated support staff. No timetable for the planned implementation was generally publicized. At this point, many of the users who had little experience with OpChart (attending physicians and CRNAs who work only in WMB) began to experiment and use the system on their own, attempting to use OpChart for some of their cases.

Although they were already using other RPCMS components, the introduction of OpChart did not go smoothly. Over the course of several weeks, a general feeling of contempt for OpChart developed among the users. Objections to the system were legion—however, they can be classified into a few broad categories. First, users felt that OpChart did not integrate well into the clinical work flow. The extra time needed to initiate and complete the charting between cases added delays to the room turnaround time. These delays were extremely unpopular with all the staff but especially with surgeons who desire to finish their cases as quickly as possible. Unfortunately, the impact of this time delay was greatest for shorter operations, which are very common in pediatrics. Also affecting short cases was the amount of time it took to document vital signs on the computer vs. the traditional paper-based system. A second complaint was that OpChart was not well suited for use with pediatric patients. Because more careful attention must be paid to managing a child's airway than an adult's airway, pediatric CRNAs commented that having to use the computer required them to have their hands off the patient for too long. Also, the database of drug information in OpChart did not

contain many common medications or the doses used in pediatrics. The system did not enable weight-based dosing for many medicines, did not allow medications to be given per rectum, and did not allow for dosing in quantities of micrograms. The result of these problems was frustration during charting and a necessity to revert to paper-based charting when obstacles were encountered. A third shortcoming was that many technical issues were encountered during the implementation. The computers used had only a mouse as a means of input, and there was a very limited surface on which to roll the mouse. One user noted that OR rooms elsewhere in RUMC were equipped with touch screens that allowed faster data input. Furthermore, a number of software bugs were mentioned as a problem. Computers momentarily paused or crashed and might require up to 10 minutes to remedy. This led to unacceptable delays in the operation and an overall mistrust in the reliability of the OpChart system. A fourth objection was that training and support were very limited. Although there was no official mandate to begin using OpChart, users felt that they were not adequately trained by the 1-hour in-service instruction. No additional classes or tutorials were available for further training, and although users trained in OpChart at other sites seemed pleased to lend assistance, they were not always available to help. Technical support was provided by the help line, although as noted previously, these staff members did not have sufficient knowledge to troubleshoot RPCMS and there was a time delay in contacting a systems expert. This delay of even a few minutes was unacceptable when a problem occurred during an operation. A final category of complaints related to the specialized culture of WMB in general. The personnel who work in WMB are focused on two types of cases: pediatrics and ophthalmology. Overall, they seemed to be resistant to a change in their work flow, and there was a belief that their current charting methods were adequate and that no change was needed. It was reported that one ophthalmology attending physician forbade the use of OpChart while he was operating. Many users felt that OpChart was a good application but that it was designed to be used with long adult cases and that it was not suitable for the type of work performed in WMB.

After several weeks of nonmandatory implementation, the resistance to OpChart in WMB reached a boiling point. One CRNA at the time noted that it was felt that the system was being imposed on them from the outside and that all the problems had led to a "climate of skepticism." Some users had suggested to the administration ways to make OpChart more usable in WMB. However, these changes were not made. Overall, both new and seasoned OpChart users felt that the implementation should end. "No one was against stopping," stated one member of the staff who remembers this event. The implementation was finally halted by Dr. McPeak. For the time being, OpChart would not replace paper-based charting as the preferred method of documentation in WMB.

A Second Effort at WMB Implementation

Although the initial deployment of OpChart in the WMB operating suites failed, a second initiative is under way to implement the tool in that location. The current plan for implementation involves a general rollout in November 2003. The hardware required for OpChart deployment was already present in the operating suites prior to implementation, and the software was rolled out in all the rooms at once—both the dedicated pediatrics and the adult ophthalmology rooms—with no pilot site. This implementation began approximately 3 weeks before the time of this writing. As before, the project manager for this effort is Dr. Doug McPeak, who is an expert in

OpChart and informatics. Two superusers, George Gibson and Charles Bertram, are serving as program champions. They are both CRNAs who have extensive experience in both using and troubleshooting the system. Dr. Steve Hays, an attending physician in anesthesiology, is not a project champion per se, but he is very familiar with the system, so he is assisting the implementation by providing assistance whenever possible to the CRNAs working on a given case. The help line staff is also responsible for supporting this second installation, although none of them is specifically assigned to the project. Last, the application developers are also available to support their product for the WMB personnel. System education once again consisted of 1 hour of in-service training led by Dr. McPeak. The switch to OpChart use is mandatory, although there is provision for paper-based charting at the discretion of the attending anesthesiologist. Moreover, it is permissible for users to "bail out" to paper charting in the event of computer hardware failure or application error that cannot be reconciled prior to the end of the operation. At present, the software is being used in approximately 50 percent of the procedures performed in the WMB operating rooms. Paper charting is primarily used for quick-turnaround cases of 15 minutes or less.

Some issues that created resistance to change in the initial implementation of OpChart in WMB have been recognized and addressed. Some of the specific technical changes that the users have requested have been implemented, including an area to record patient body weight, the capability for weight-based drug dosing, dosing in micrograms, and new routes for administration that are useful for pediatric caregivers. Some hardware issues have been causing users trouble. One user noted: "Have a network that is capable of handling [OpChart]. I know it is not that simple, but it seems that the more traffic, the more traffic tie-ups. I am not a computer guy, but the network and the servers need to able to handle the traffic, whether it is 6 A.M., 12 noon, or 8 P.M." The perioperative informatics group has been proactive in addressing these issues. For the one OR in which users have been experiencing extreme hang-ups and freezes, they are rewiring the network cables to that room at their own expense. Moreover, they are bringing in a computer known to be good to test it in the room and see if the problem is with the computing hardware instead of the network. One user notes that it remains difficult to attend the official OpChart forums, but more peer support is available at the present: "It is hard to attend the Gas Chart Forums that are held in the Control Room. Often, they are held at 6:30 A.M.—those of us working in the WMB usually have 7:00 A.M. starts and are unable to attend. Other informal meetings are held during the day—I'm usually in a busy room. This time around, people have been around to listen." Another user likewise notes the improved user support but wishes that the WMB operating rooms did not have to go live all at once: "We have provided a lot of feedback. I feel like we have been listened to and several things have been changed. However, I feel like it should have been implemented in one room first with a small number of people to try it and find things to be changed, before it was started in all the rooms."

Of note, a few issues might arise in the plan for implementation of the system. No formal mechanism has yet been developed to evaluate and learn from this implementation as it progresses. Dr. McPeak reviews the surgeries that were done with the paper-based system to discern why they were not done using the OpChart system. Also, users were not well informed about the timeline for change. One user said, "I'm not sure that I know the timeline for the change." Another commented that the change will occur "when a system is available that meets the end user's needs for charting, speed, and reliability. When any of these are missing or lacking, it creates much frustration to new users and old ones as well." In other words, it will happen "when the system is ready."

Also, training again consisted of only 1 hour of in-service instruction, this time from Dr. McPeak. Charles Bertram suggested that it might have been even more useful if training involved a 2-hour one-on-one session with him or some other superuser who has more time available to spend with individual users than an anesthesiology attending physician. Another user suggested that the training that was conducted might be inadequate: "At the in-service there were problems with people signing on and a problem with the instructor being able to show us everything they wanted to, not because of time, but because it could not be done where we were being taught." Also noteworthy is the fact that the end users of the system have very little stake in the implementation of OpChart in the WMB operating suite. Additionally, the benefit that would be achieved by a successful deployment of the software will be reaped by the hospital and WMB administrators, but it will not directly serve the end users of the system.

A number of issues have already arisen in the presently ongoing implementation of OpChart. Not all users are enthusiastically putting forth an effort to aid the system's adoption. One particular user at the site very quickly bailed out to the paper-based system on two occasions out of frustration. As a general rule, some people are very resistant to this change in WMB. Some staff members believe that for short operations, using OpChart will increase the documentation time and thus lead to slower OR turnaround time, which will create more costs to outweigh any of the benefits achieved by the system. There is a belief that they do not need to change because current documentation techniques are adequate. Indeed, one CRNA has informally threatened to quit if OpChart use is made mandatory. Possibly as a result of the prior failed implementation, some negative feelings already existed before the present implementation ever started. A sentiment of "I don't want to do this" exists. One CRNA reported that for some users, "If they can find any excuse to change to paper, they will." Some attending physicians are also resistant to OpChart—in particular, surgeons don't like to see a CRNA with their back turned to the patient. Some of them have a perception that it takes away from their ability to care for patients. Surgeons expect the anesthesia staff to be patient-centered, not computer-centered, during an operation—particularly during pediatric operations. As one user summed it up, "Kids just need to be watched a lot closer, period."

Some technical issues also appear to be barriers to adoption. The speed of the computers remains a common complaint. The system appears to be slow, causing a great many lock-ups. One user points out how this slows down their work flow: "The longer and busier the day, the longer it takes to start and to chart . . . 5 to 10 seconds here, 30 seconds there, 2 or 3 minutes to boot-up, 10 minutes to reboot in the OR may not seem like much time, but with shorter cases and quicker turnovers between cases, it really slows us down." Another user laments the ever-recurrent "fickle hourglass" that appears on the computer screen when it is processing—"I swear that it knows when one is trying to finish a chart or start a case." One operating suite is notoriously slower than any of the others, but as mentioned earlier, this issue is being addressed. Also, users are frustrated by the slowdown that occurs when one is required to wade through multiple log-in screens at the beginning in order to access the system. They would prefer to enter their user name and password once and then have complete access as needed. This issue has been raised with the Department of Anesthesiology administration as well as with the help line.

Ergonomic issues are again a point of contention in the OpChart implementation. Some users wish that they were more flexibly mounted. One comments, "I find that I am having more neck pain even though I have tried to position the computer to help

me. For adult eyes, a few of the attendees spend a lot of time on the room workstation when they could use another workstation—what about laptops or something that is more portable?" One user feels that the computers are poorly mounted: "The mounts are not stable. To stay in one position, you have to have a support under them." Some computers may be difficult for the user to reach during an operation, and users need to keep two hands on the patient as much as possible. Thus, input devices remain an issue. There is very little room for moving the mouse. One user seems to be envious of the input abilities in other areas: "The computers do not have touch screens, unlike many of the computers in other places. . . ."

Support for the end users will play a key role in determining the success of the present OpChart implementation, and some users currently have an issue with insufficient support. Moreover, the help line, which serves as the official front line of support for OpChart, is not trained in the use of the system. As one user noted, "On day one we had good support, day two was only one person and we asked for that. We do not have the ability to talk directly to a clinical person with a problem. We have to call the help line and talk to a nice person, but they have no clue as to the frustration you experience when error screens pop up and you are trying to take care of a patient." Because the OR is a pressing environment where delays may carry significant consequences, users would like to have on-site support available. "I do not feel like we as clinicians should have to call the desk, report the error messages, tell what we were doing immediately prior to the message coming up, and take care of a patient at the same time. It distracts us from the patient. A computer 'guru' should be here in the operating rooms to handle problems." Finally, the relay mechanism for support, whereby the help line pages the on-call anesthesiology support person, can be frustrating to users because of the delay it causes. "Being told hang on, I will page someone, I will call you back, etc., does not help when a case is finishing." Users are relatively helpless to accomplish their designated clinical tasks during this time period if they are reliant on support to help them continue using the computer system. This may further encourage reversion to the paper-based system.

Evaluation and Conclusion

In this case study, the authors have described efforts to implement a medical informatics system in a suite of operating rooms used for pediatric surgery and adult ophthalmic surgery. Although this system has been readily accepted by all other surgical units within the medical center, successful adoption in this one area has been elusive. Although they care for a specialized patient population with a different case mix from other surgical areas, there is no single factor that stands out as the most direct cause for the failed initial deployment. Both short operations with a rapid turnover and pediatric cases are performed in other surgical areas where OpChart is used successfully. In addition, rotating anesthesiology residents who are already accustomed to using OpChart in other surgical areas seem to be able to use it effectively in WMB as well.

The difficulties encountered during OpChart implementation in the WMB operating suite seem grounded in two main areas: technical issues and cultural issues. The technical limitations of the system led to the opinion that the application is not well-suited for use in this area, and that the system lacks some functionality that would have made it better suited for use in this environment. These complications were exacerbated both by a relative low level of training and preparation of the users for implementation, and by technical support that has been insufficient for a demanding surgical

environment. Nonetheless, some of these limitations likely existed and were overcome during the OpChart adoption in other areas. Thanks to ongoing development of the OpChart software, some of these technical issues were addressed prior to the start of the present implementation, but other problems still remain—particularly those with hardware and network slowdowns and with difficult OR ergonomics. Cultural and organizational barriers seem to be another significant barrier to acceptance of the OpChart system in the WMB operating rooms. The highly specialized, self-sufficient pediatric anesthesiology staff members have demonstrated a low perceived need for the documentation tool. They became fixed on the system's imperfections and ultimately viewed the product as a potential liability rather than as a beneficial tool. A negative bias toward the software persists after the first deployment. Finally, the staff members seem to view the proposed implementation of OpChart as being imposed on them by outside forces. They have no sense of ownership of the project because the implementation is being forced on them by those higher up in the RUMC hierarchy. This sentiment likely further increases their resistance to adoption.

Three years have passed since the first incident of failure, and now another attempt is being made to bring OpChart into WMB. Many obstacles still remain in the path of successful adoption of the software. This unique blend of cultural and technical roadblocks may prove to be difficult to conquer. However, none of these problems are likely to be insurmountable given time, patience, and responsiveness on the part of all parties involved. The future of the current OpChart implementation in WMB hinges on the ability of the administration, developers, and end users to recognize the difficult issues, lying in the path to success and to find a means of overcoming them.

Questions

1. What problem(s) was OpChart intended to address? Who perceived these issues to be problems?
2. What factors contributed to OpChart's poor reception in WMB? Could they have been anticipated or mitigated?
3. From a behaviorist point of view, comment on the positive and negative reinforcers that influence users of OpChart. How were these reinforcers different in WMB?
4. What would you do to increase the probability that OpChart will have a successful reimplementation?
5. What extra costs would you incur in order to address user complaints?
6. What are the implications of another unsuccessful implementation? What are the sunk costs already incurred?