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Downtime procedures for a clinical information system: a critical issue

Nancy C. Nelson RN, MS*

Intensive Medicine Clinical Program, Intermountain Healthcare, Salt Lake City, Utah 84111, USA

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Abstract As computers become embedded in clinical workflow processes, disruptions to access can have serious consequences. The Health Evaluation through Logical Processing system at LDS Hospital is a computerized hospital information system that has been under continuous development for more than 30 years. The system maintains a 99.85% uptime and averages more than 17 000 logons per day. The first formal downtime plan for this system was developed in 1992 in anticipation of a major hardware installation. In early 2000 after a series of planned downtimes from which we did not recover smoothly, our Software Oversight Committee became interested in understanding downtime procedures. A downtime plan for clinical users was developed and tested and is discussed. A March 2000 downtime survey of 103 clinical staff provided additional information to refine the plan. The downtime plan now includes explicit instructions about the clinical data that must be reentered after a downtime and also includes a plan for a regularly scheduled downtime practice drill similar to a fire drill.

1. Introduction

As computers become embedded in daily workflow processes, it is difficult to imagine life without them, even for a few hours. The consequences of our increased reliance and dependence on computerized information systems become evident when these systems fail, particularly in the health care setting [1-5]. A computer system crash at Beth Israel Deaconess Medical in November 2002 blocked access to patient records, prescriptions, laboratory reports, and other information for 3 1/2 days. Although hospitals, including Beth Israel, had prepared downtime disaster plans for the Y2K situation, the opportunity to use or practice the plan did not materialize in 2000, and the plans were soon outdated and forgotten [6].

Uptime of mission-critical clinical applications is an important marker for those who depend on that data to make decisions as well as those who monitor the operational and financial impact of systems. A study by Anderson Consulting Group Inc done in 2001 determined the cost per minute of downtime for an average 3-hospital integrated delivery network with 1400 beds to be more than $1000 [3].

The Health Evaluation through Logical Processing (HELP) system at LDS Hospital has been an integral part of the patient care process for clinicians since the late 1970s [7-9]. Clinicians have come to depend on system availability and take its reliability for granted [10]. Dependability and reliability are trademarks of the HELP system at LDS Hospital: with a 99.85% uptime

* Tel.: +1 801 442 3505.
E-mail address: nancy.c.nelson@intermountainmail.org.

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(13.14 hours of downtime per year), it is no wonder clinicians have high expectations of the system [11]. Decision support capability in the HELP system assists clinicians in decision-making including antibiotic selection, detecting medication incompatibilities, ventilator weaning protocols, blood gas interpretation, and adverse drug events detection [12]. The system is used by a wide variety of clinicians (physicians, nurses, respiratory, and physical therapists) for both clinical data entry and data review. A survey of the number of logons in May 2003 recorded more than 17,000 logons for an average 24-hour period. Nursing staff accounted for 73% of the logons and physicians accounted for 11%. Patient care workflow is highly dependent on optimal system performance and the ability to have immediate and ubiquitous access to computer terminals and patient clinical data [11]. The question then arises, what happens when an integrated health care system has a downtime, planned or unplanned? For example, gaps in patient data may occur if data are not "back-charted" into the record after a downtime. Issues surrounding the loss of data integrity in the electronic record due to downtimes are not well documented in the literature. What is the impact of computer downtime on a healthcare facility? How are downtimes planned and dealt with? These issues became pertinent at our facility as we looked at the downtime process and procedures and are the focus of this article.

2. Evolution of a downtime plan

The need for a formal computer downtime plan was first recognized at LDS Hospital in 1992 to accommodate new hardware installation that was projected to require a 36-hour downtime. This major disruption in the workflow would have had a huge impact on patient care processes if not carefully staged, so planning for the downtime began 6 months before the event. A committee with representation from every clinical department using the computer system met to develop the downtime plan. The plan was detailed and included methods for each computerized process that would require a paper process during the downtime. As soon as the hardware installation was complete, the downtime plan remained essentially unchanged until early 2000. After a series of planned downtimes from which we did not recover smoothly and an unplanned downtime due to a rare Utah tornado, in Salt Lake City on August 18, 1999, our Software Oversight Committee (SOC) became interested in the quality of our downtime procedures and encouraged committee members to look at the impact, adequacy, and familiarity of downtime plans for their departments. The LDS Hospital SOC was a multidisciplinary group with representation from nursing, pharmacy, respiratory therapy, laboratory, information systems, hospital administration, quality, and risk management established in 1998 to ensure computer software does not pose threats to patient safety or impact the integrity of clinical practice [13].

3. Developing a system downtime plan

The following information about downtime planning was the result of years of experience with planned and unplanned downtimes at LDS Hospital. This information can easily be adapted as a beginning downtime planning checklist for a facility using electronic documentation.

4. Computer downtime date and time

Downtimes for the HELP system at LDS Hospital are of 2 types: (1) planned downtimes scheduled in advance for routine hardware maintenance and software upgrades and, (2) unplanned downtimes that are due to circumstances out of direct control. Dates for planned downtimes are scheduled monthly and are cancelled if no maintenance is required. Downtime is generally scheduled to begin at midnight Tuesday night and continues into Wednesday morning. Tuesday night was selected because it allowed for 2 working days at the beginning of the week for the information system (IS) team to prepare for the downtime. Based on measurements of order volume, number of results coming across the interface, and number of logons per hour, times of least activity are between 1:00 and 4:00 AM. Based on this information, downtimes are planned from 12:00 midnight to 5:00 AM. The 5:00 AM uptime is crucial. The next shift arrives at 7:00 AM, and the staff and the clinical data need to be ready to provide accurate and timely reports so that shift change can occur smoothly.

5. Downtime notification

When a downtime is planned, clinical staff notification is handled via several mechanisms. First, a logon message seen by all system users is placed on the Monday morning before a planned Tuesday night downtime. Second, email notification is sent to all hospital department managers on the Monday before the downtime. Third, on the evening of the downtime, overhead loudspeaker announcements are made by the hospital telephone operators at 10:00 PM and 12:00 midnight.

When unplanned downtime occurs, notification is usually handled by overhead loudspeaker announcements. The hospital telephone operators use a predefined set of messages and are instructed by a member of the IS team which message is to be read. The announcements state the type of downtime and the potential length of the downtime if a reasonable estimate can be determined. Pager notifications are sent to the IS team to alert them of unplanned downtimes or other critical system events.

6. Downtime documentation procedures

Downtime policies and procedures for each department state what "backup paper" forms and processes are used to document patient care and communicate with other departments during downtimes. The nursing staff uses a paper downtime flow sheet. The flow sheet is used for patient care documentation during a downtime and can become part of the permanent patient record if the data are not "back-charted" into the computer at the end of the downtime. The dilemma surrounding "back-charting" of data is at what point does the cost of clinicians staying late to reenter data outweigh the benefit of having all of the data in an electronic format. What is the impact of having "holes" in the electronic record? How will clinicians know that they are not seeing complete data sets when reviewing an electronic record? These issues must be addressed when determining whether to "back-chart" data into the computer after a downtime.

7. Data access issues

Access to clinical data during a downtime is 1 of the biggest challenges faced when an electronic patient record is used. Inability to access clinical data during an unplanned downtime places clinicians in a potentially vulnerable situation. The computer is their primary source of data. With the exception of the nursing shift report, which is printed every 12 hours, our facility does not routinely print data and place it in a paper chart. The shift report contains most of the patient's numeric data including the following details: vital signs, pressure measures, medication administration data, intake, output, ventilator data, and blood gas data [14]. Before the start of a planned downtime, the nursing units can print out temporary shift reports, medication worksheets, and laboratory results for use as reference if needed. In addition, a laboratory results notebook is brought to each unit by laboratory staff before the start of the planned downtime and also when any unplanned downtime occurs. The notebook is to be used to record results that are received from the laboratory during the downtime. Critical and statistical results are routinely phoned to the nursing units and a computer downtime does not change that process.

If an unplanned downtime occurs, we rely on the most recent printed shift report and any temporary worksheets or physician rounds reports that may have been printed to provide data until the system is operational again. The manually recorded downtime paper record has patient information from the beginning of the downtime.

8. Downtime survey

As part of the SOC effort to evaluate the effectiveness and consistency of LDS Hospital's downtime policies, a survey designed to evaluate the impact of the downtime on the staff, assess their familiarity with downtime procedures, and determine the adequacy of the existing plan, was developed, distributed, and compiled by the ICU clinical nurse specialist and the clinical information systems (CIS) coordinator (both are members of the SOC). Results of the survey were used to enhance the downtime plan for nursing and identify area of improvement for other departments.

The survey consisted of the following 5 questions:

1. How do you feel the downtime affected your workflow this shift?
2. Did you have any problems communicating with other departments during the downtime?
3. During this downtime what did you use as a charting form to record data?
4. What data did you back chart into the computer at the end of the downtime?
5. Is there anything else you would like to tell us about the downtime?

Multiple-choice responses were provided for the first 4 questions along with a space for "free-text" comments. An open-ended response was expected for the fifth question.

The survey was distributed to nursing staff and respiratory therapists working during a planned downtime on March 22, 2000. The downtime began at 12:30 AM and lasted until 4:00 AM. At 5:00 AM,surveys were distributed to all night shift clinicians (nurses, nursing assistants, and respiratory therapists) by the CIS coordinators. A total of 103 survey forms were distributed among 15 nursing units and the emergency department. A total of 79 (77%) survey forms were returned. See Table 1 for survey results.

9. Survey recommendations

The CIS coordinator and clinical nurse specialist using the results of the downtime survey developed a number of recommendations that were presented to the SOC in April 2000. These recommendations are as follows:

(1) Survey results indicate that the length of the downtime is important. In general, 4 hours was determined to be tolerable but 6 hours was too long. Fifty-seven percent of the returned survey forms had free text comments and 53% of those comments were related to the length of the downtime being too long. The other factor that was important to the staff was that the computers come up at the predetermined time communicated in the downtime information. Delays in the scheduled "up-time" are very disruptive.

(2) The survey confirmed that there is confusion on the part of the nursing staff as to what data they must enter into the computer after a downtime and who is responsible to enter that data if the downtime crosses

Table 1 Downtime survey results

DOWNTIME questionnaire, March 22, 2000								
Question		Very disruptive	Disruptive	Inconvenient	No real impact	N/A	Total	
1. How did you feel the downtime affected our workflow this shift?	N (%)	29 (36.7%)	16 (20.3%)	33 (41.8%)	0 (0.0%)	1 (1.3%)	79 (100.0%)	
Comments:								
		Yes	No	N/A	Total			
2. Did you have any problems communicating with other departments during this downtime?	N (%)	30 (38.0%)	49 (62.0%)	4 (5.1%)	79 (100.0%)			
Comments:								
		Downtime sheet	Scrap paper	IV worksheet	ICU flow sheet	Paper MAR	N/A	Total
During the downtime, what did you use as a charting form to record data?	N (%)	32 (40.5%)	38 (48.1%)	8 (10.1%)	1 (1.3%)	16 (20.3%)	11 (13.9%)	79*
Comments: *More than 1 answer selected								
		VS	Meds	I/O	IV Fluid	Pt Care	Assessment	Total
What data did you "back chart" into the computer at the end of the downtime?	N (%)	58 (73.4%)	63 (79.7%)	60 (75.9%)	52 (65.8%)	48 (60.8%)	30 (38.0%)	79*
Comments: *More than 1 answer selected								
		Free text comment	No comment	Total				
Is there anything else you would like to tell us about downtime?	N (%)	45 (57.0%)	34 (43.0%)	79 (100.0%)				

N/A indicates not applicable. IV, intravenous; MAR, medication administration record; VS, vital signs; I/O, intake/output; Pt Care, patient care.

change in shift boundaries. To overcome this confusion, clear standards on post-downtime computer data entry by nursing were needed.

(3) Survey results indicated problems with laboratory communication. The survey question: "Did you have any problems with communicating with other departments?" prompted 15 written comments, 11 or which referred to laboratory workflow processes. These problems were due to a lack of familiarity with the laboratory downtime plan on the part of the nurses and the laboratory staff. Therefore, it was recommended that both nursing and laboratory staff become more familiar with the downtime process for laboratory ordering and specimen identification.

(4) Accessing automated medication carts was an issue for units using them. Patients admitted during downtime are not in the cart census and drugs cannot be easily dispensed for those patients. Recommendations were for pharmacy to incorporate automated medication dispensing processes into the downtime plan to provide consistent access methods during downtimes.

10. Nursing downtime plan

Survey results were used to develop a clearly defined downtime plan for nursing. The downtime survey pointed out that the nursing department needed specific guidelines as to exactly what data would require "back-charting" into the computer after a downtime. Although nursing had always had a preprinted downtime flow sheet, there were no written instructions to guide nurses as to when it should be used and at what point it could become the permanent record. At the request of the SOC, the nursing leadership council developed new downtime documentation guidelines providing specific details as to what data had to be entered into the computer, who was responsible to enter the data, and what data could remain on the downtime flow sheet. Respiratory therapy and pharmacy downtime policies were also updated and followed the policy format used by nursing. The following is a summary of the nursing policy:

11. Nursing downtime documentation policy

1. Patient information collected during any computer downtime will be documented on the downtime form. Downtime forms are to be kept as part of the permanent record even if the data are later entered into the computer.
2. When the computer system is operational again, patient care personnel will enter data from the downtime forms using the following guidelines:
   - A. Downtime less than 4 hours
     1. If no change in nursing provider occurred during the downtime, all data recorded are entered into the computer at the end of the downtime.
     2. If nursing provider changed during the downtime period, the nurse currently caring for the patient will enter only vital signs and measurements, intake/output, medications, and infusions from the downtime form.
   - B. Downtime greater than 4 hours but less than 24 hours
     1. The nurse currently caring for the patient will enter only vital signs and measurements, intake/output, medications, and infusions from the downtime form.
     2. Document the phrase "see downtime form" in the computer problem/event module.
     3. Document the phrase "entered in computer" on the downtime MAR.
   - C. Downtime greater than 24 hours
     1. Document the phrase "see downtime form" in the computer problem/event module.
     2. Nursing data is not "back-charted" into the computer, the downtime form is the record.
     3. Send pharmacy a copy of the downtime MAR for billing purposes.

12. Discussion and conclusions

The review of our downtime plan revealed that our clinical staff was not well versed in the details of the plan and were unprepared to deal with downtime whether planned or unplanned. Our experience with downtime plans suggests that such plans are a necessary step, but that downtime plans alone are not enough. Plans that are not used tend to be neglected and are quickly outdated. A downtime plan will be only minimally effective unless the staff have the experience of actually using the plan. In our experience, planned downtimes are not a good method of preparing staff for unplanned downtime. If the purpose of downtime planning is to prepare the staff for both planned and unplanned downtimes, then all staff should have the opportunity to practice the plan, not just those who happen to be working during a planned downtime. In an effort to include more staff in the downtime strategy, we are implementing a "downtime drill" similar to the concept of a fire drill. The drill consists of facility walkthroughs by designated emergency preparedness team members and the IS staff. A similar concept is currently used in our facility by the emergency preparedness team to assess staff knowledge of fire safety procedures. The team physically visits various hospital departments for the purpose of assessing staff knowledge of the downtime plan, and observes first hand their ability to explain the plan to the team. Questions such as, "Do you know how to order this test if the computer were not available?" or "How would you find a patient's laboratory value if the computer was down?" "What information will be entered into the computer after a downtime?" are asked of staff. Drills are scheduled on a regular basis and all departments with computerized processes are included. We feel this proactive approach better prepares the staff for downtime, planned or unplanned.

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