449

Strategies in Electronic Medical Record Downtime Planning: A Scoping Study

Joseph M. WALSH [a,1], Elizabeth M. BORYCKI [a] and Andre W. KUSHNIRUK [a]

[a] *School of Health Information Science, University of Victoria, Victoria, British Columbia Canada*

Abstract. PURPOSE: This review will identify dominant themes, common to published articles that discuss downtime planning in a clinical setting. These common themes will represent key considerations for healthcare organizations' comprehensive downtime plans. METHOD: A scoping study was performed using search results from PubMed, CINAHL and Medline. The 4 articles meeting the inclusion criteria were analyzed for common themes and findings. RESULTS: Four common themes were found in the included articles: 1) Communications plans, 2) Procedure review and revision, 3) Managing system availability and 4) Preparing staff for handling incidents. CONCLUSION: Organizations must have comprehensive downtime plans available to ensure continuity of patient care during the periods of limited availability. A comprehensive downtime plan that includes these four strategies can become the framework for a set of organizational procedures that ensures the best possible access to vital patient information before, during, and after a downtime event.

Keywords. electronic health record, healthcare information system, EMR, EHR, HCIS, downtime mitigation, contingency planning, patient safety

1. Introduction

With Electronic Medical Record (EMR) systems being deployed in healthcare organizations, clinician reliance on these systems for patient information has increased. When those systems experience downtimes, they create gaps in information and care processes that can have an effect on patient safety and the continuity of care of patients [1-3]. Data gathered from incident reporting tools, as well as in depth analysis of laboratory information systems (LIS) study turnaround times have provided valuable insights into the clinical impact of downtime events. Such analysis of the data in conjunction with observations of effects of downtimes on clinical workflow during a downtime event help to illuminate gaps in formal downtime plans that need to be addressed. In this review the authors will identify key themes emerging from the literature focusing on downtime planning in a clinical setting. These common themes represent key considerations for healthcare organizations' development of comprehensive downtime plans.

---

[1] Corresponding Author: Joseph M. WALSH. Email: jmwalsh@ndrn.net

2. Method

Following a scoping study methodology [4], searches were performed on CINAHL, PubMed and Medline for articles including the terms "downtime", "planning" and "electronic medical record" (EMR) as well as grouped with similar terms "emr", "electronic health record" (EHR) and "ehr". A total of 16 articles published before May 2018 were returned from all sources. Nine non-duplicate articles advanced to title screening where four articles were excluded. One additional article was excluded after abstract screening as shown in the flow diagram in Figure 1. Four articles were included in the review as they referred to downtime planning. A narrative review of the abstracts was conducted for key words and information that would allow for the research questions to be answered [5]. The findings from these works were summarized and collated to identify common topics and subjects across studies.

3. Results

Few published studies exist at this time regarding downtime planning. In particular, authors have noted that there is a gap in training frontline providers and little guidance overall in preparing downtime procedures [3,6,7]. "Research on EHR downtime, particularly in acute hospital settings, is in its infancy" [3]. Despite this gap, several common themes still emerged. Recommendations for process improvement to reduce the clinical impact of planned and unplanned EMR downtime events were the most common themes that emerged. The authors found that mitigating downtime effects allowed for
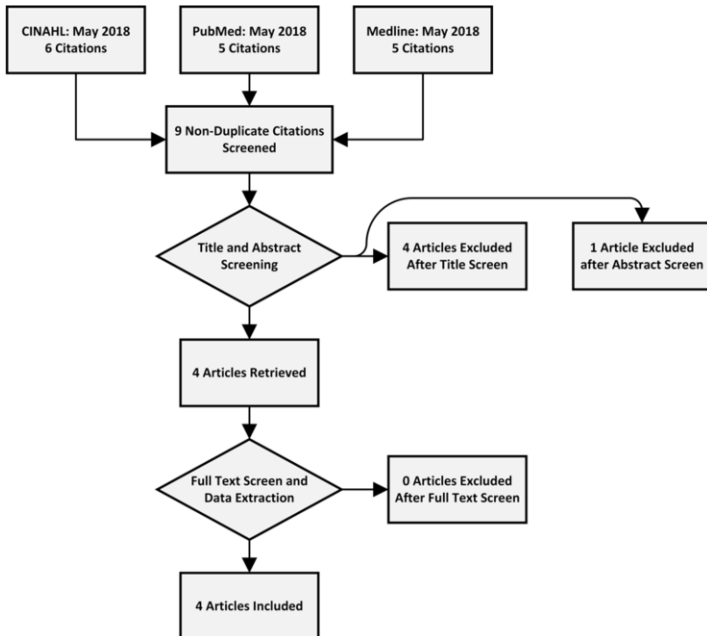

Figure 1. Study Selection Flow Diagram.

there to be a focus on processes, equipment and procedures before, during, or after a downtime so that there would be minimal adverse effects on patient safety and continuity of care. The identified studies further focus on four main thematic areas to be considered when planning for downtime events, namely communication plans, procedure review and revision, managing systems availability and preparing staff for downtimes. In the next section of this paper the emergent themes will be discussed in more detail.

3.1. Communication Plans

Keeping the organization informed about downtime events is critical to clinical operations. In planned downtime scenarios, communication plans can insure that clinical units have an opportunity to best plan for the potential workflow and staffing changes needed in advance. During a downtime, departmental and clinical managers should be notified as needed so that they can adjust staffing levels or ensure that preprinted forms or medication administration records (MAR) are on hand prior to the planned downtime [3,8]. In some situations, key stakeholders may be invited to participate in downtime planning sessions. In both planned and unplanned systems downtimes, staff notifications are essential as they make affected staff aware of the downtime and any known expectations for the duration of the downtime. These communications can take the form of any combination of overhead paging and emails to affected staff [8]. Depending on the expected length of the downtime event, researchers have documented that in-person rounds to affected areas to assist with downtime procedures and initiating action plans is an asset. Involving the senior leadership team in these rounds can also demonstrate support for the process in patient care areas [8]. It is essential that communication plans include methods for exchanging important patient care information such as orders and results between departments such as clinical units and the lab or pharmacy are essential to address from a patient safety perspective [3,8]. When the health information systems have reached an acceptable level of stability and availability, informing staff of the 'all clear' will allow for a smooth transition back to normal operations. Following both planned and unplanned downtime scenarios, appropriate follow-ups with clinician and administrative stakeholders in affected areas who can provide feedback on the process should be included as an activity for planning future downtime events [3,8].

3.2. Procedure Review and Revision

Established procedures for patient care systems downtimes are a necessity in clinical areas. These processes should be formal, documented plans that are reviewed on at regular intervals and revised appropriately to maintain their currency [3,8]. For some areas, informal plans or workarounds may exist between staff familiar with full downtimes, or functional downtimes when only a portion of the system is unavailable [3]. These informal practices should also be captured and documented so that clinical managers and technical staff are aware of the processes and may suggest improvements to improve availability of systems, reduce the severity of downtime events, and minimize the impact to patient care [3,8]. Following a downtime event, these processes and procedures should be reviewed with key stakeholders so that formal downtime documentation can be updated to best reflect the processes that best maintain continuity

of care in clinical areas. These processes will also include the procedures required to capture required clinical information so that patient information can be after the system returns to a normal state [3,8]. Processes and procedures should also be reviewed on a recurring basis to capture changes to the clinical workflow that have occurred since the last review. Organizations may choose to review these processes semiannually and establish a downtime committee to be responsible for involving the appropriate stakeholders from clinical practice, organizational management, health information systems and communications departments [8].

3.3. Managing System Availability

Planning for downtime includes initiatives that an organization undertakes to increase system redundancy and availability. These plans can reduce the likelihood of an unintended downtime, or mitigate the effects of such occurrences when they do occur. Backup systems can include items such as uninterruptable power supplies (UPS) and standby emergency power generation. Backup systems can also include data archives or repositories to provide an alternate source of clinical data for long downtime periods [3,9], or for recovering clinical information in a disaster recovery situation. Distributed or clustered systems may be built out so that planned maintenance can be performed with minimal interruption to system availability and data integrity. Redundant systems can be staged at a 'warm site' to provide alternate electronic systems in the event of an unplanned downtime, however, they may take time to bring fully them online and accessible to clinical staff throughout the organization [3,8,10]. These redundant systems may be best used in an unplanned, extended downtime since they are not typically instantly available, and some time may be needed to reconcile any data captured in a redundant system once the primary system returns to service [8]. Backup media such as tape, or an offsite, disk-based archive can preserve clinical data and systems states to reduce the time required to restore the organization's systems to a functional state so that the clinical information can be restored [8,10].

3.4. Preparing Staff for Handling Incidents

To ensure continuity of patient care and a consistent application of downtime policies and procedures, all staff affected by downtime should be appropriately trained in downtime procedures. Studies in this review found that while all organizations surveyed had trained their staff on their documented downtime procedures, over two thirds of those organizations do not perform regular downtime drills on any shift [10]. Regular, unannounced downtime drills can further educate staff to documented downtime procedures. Combined with procedure review, these drills can also serve to refine the established downtime documentation and provide more insight to the information required during a downtime [3,8,10]. Many organizations also choose to equip organizational units with downtime documentation toolkits that are designed or refined as a result of live downtime scenarios, downtime testing and downtime drills. These toolkits can provide preprinted forms to facilitate information capture, and streamline the back loading process when the system returns to normal functionality [3,8]. Regular testing of downtime equipment is not being performed by the organizations surveyed in the included studies. Although all of the included organizations have uninterruptable power supplies in their organization, only half of these organizations perform monthly testing. Less than 80% of the organizations included tests of their emergency electrical

generators on a monthly basis, 21% of them did not have fuel storage that would last for more than two days despite 96% of the organizations stating that they have standby emergency power generators [10].

4. Discussion

Systems downtime is inevitable in today's clinical settings. In a survey of large integrated health systems in the United States, 95% of the respondents reported to have had experienced at least one unplanned downtime event in the past three years. In the same survey, 70% of those organizations experienced at least one unplanned downtime lasting longer than eight hours in the same three years [10]. Clinicians are becoming more dependent on the advanced alerting features, which are common in many current EMR deployments [3]. These alerts can notify of potentially harmful interactions, particularly in medication orders. During downtime scenarios, it is important to consider what actions can be taken to preserve the integrity of the patient information available during normal operations.

Establishing in depth plans for downtime scenarios can prepare technical, and clinical staff and managers for downtime events when they occur. These plans include preparing patient information ahead of a downtime so that as much information as possible is available to the clinical users. These plans also can help clinical staff prepare for capturing the appropriate information during the downtime, and facilitate entering the captured information in to the EMR when it becomes available again [8,10]. These methods can help provide a continuous level of patient care during downtimes.

Clinical users, technical staff, and organization management should have frequent status updates during unplanned downtimes. These users also benefit from as much advanced notice as is appropriate to the situation so that they can prepare for a planned downtime. Strong, established communications plans should include notifications to appropriate staff at the beginning of a downtime to announce that clinical staff should now be following downtime procedures. During a downtime, clinical staff benefit from regular status updates so that they may stay informed of the expected end of the downtime. Following the outage, clinical staff must be informed that it is safe to return to normal procedures. In a planned downtime situation, senior organization staff should be informed of the outage details so that staffing levels can be made in advance, and to ensure that the clinical units have all the relevant patient information possible before entering into downtime procedures [8]. The subject organizations that were studied in the included articles all reported that staff receive training in downtime procedures. It was found, however, that less than a third practiced regular, unannounced, downtime drills on any shift at least annually [10]. Testing of downtime procedures does not need to be limited to clinical staff. Downtime testing and downtime training should include day to day users of the system, as well as regular, scheduled testing of backup and redundant systems designed to mitigate the effects of downtimes [8,10]. Managing system availability can reduce the likelihood of a failure, though maintenance must still be regularly performed and may create the need for planned downtime events. Regardless of the nature of the downtime, organizations should take the time following any planned or unplanned downtime to review how well the downtime procedures were understood on the clinical units and what can be done to strengthen their downtime procedures [8,10]. Downtime procedures should be reviewed at least annually to ensure that they continue to meet the needs of the clinical unit [8].

5. Conclusion

EMR downtimes are inevitable. Regardless of whether the downtime was planned for routine maintenance, unplanned, partial or a complete outage, organizations must have comprehensive downtime plans available to ensure continuity of patient care during the periods of limited availability. Downtime planning includes strategies to reduce the likelihood of unplanned outages or mitigating the effects of unplanned outages with backup and redundant systems to manage availability. Communication plans must be established to keep clinical and technical staff informed of critical outages, and provide escalation procedures to the organization's management. It is essential that clinical staff know how to follow downtime procedures through training, or even unannounced downtime drills. Organizations must also keep their downtime plans current with frequent reviews, especially following any outage or downtime drill. This review process can capture or correct clinical staff's workflow during periods of limited availability. A comprehensive downtime plan that includes these strategies can become the framework for a set of organizational procedures that ensures the best possible access to vital patient information before, during, and after a downtime event.

References

[1]   Y. Wang, E. Coiera, B. Gallego, O.P. Concha, M.S. Ong,, G. Tsafnat, D. Roffe, G. Jones, F. Magrabi, (2016). Measuring the effects of computer downtime on hospital pathology processes. *Journal of Biomedical Informatics* **59** (2016), 308-315, doi:10.1016/j.jbi.2015.12.016

[2]   U. Sax, M. Lipprandt, M. Lipprandt, M Fau, R. Rohrig, The rising frequency of IT blackouts indicates the increasing relevance of IT emergency concepts to ensure patient safety, IMIA *Yearbook of Medical Informatics,* **10**(1) (2016), 130-137.

[3]   E. Larsen, A. Fong, C. Wernz, R.M. Ratwani, (2017). Implications of electronic health record downtime: an analysis of patient safety event reports, *Journal of The American Medical Informatics Association: JAMIA* (2017) doi:10.1093/jamia/ocx057

[4]   H. Arksey, L. O'Malley, Scoping studies: towards a methodological framework. *International Journal of Social Research Methodology* **8**(1) (2005), 19-32.

[5]   H.L. Colquhoun, D. Levac, K.K. O'Brien, S. Straus, A.C. Tricco, L. Perrier, M. Kastner, D. Moher, Scoping reviews: Time for clarity in definition, methods, and reporting. *Journal of Clinical Epidemiology* **67**(12) (2014), 1291-1294, doi:10.1016/j.jclinepi.2014.03.013

[6]   D.T. Kashiwagi, M.D. Sexton, C.E. Souchet Graves, J.M. Johnson, B.I. Callies, R.C. Yu, J.M. Thompson, All CLEAR? Preparing for IT downtime. *American Journal of Medical Quality: The Official Journal of The American College Of Medical Quality,* **32**(5) (2017), 547-551. doi:10.1177/1062860616667546

[7]   E. Larsen, C. Haubitz, C. Wernz, R. Ratwani, R., Improving electronic health record downtime contingency plans with discrete-event simulation. Paper presented at the *49th Annual Hawaii International Conference on System Science*, Hawaii (2016).

[8]   P.S. Coffey, S. Postal, S.M. Houston, J.W. McKeeby, J. W., Lessons learned from an electronic health record downtime, *Perspectives in Health Information Management*, (2016), 1-7.

[9]   F. Campos, D. Luna, D.F. Sittig,, F.G. Bernaldo de Quirós, Design, implementation and evaluation of an architecture based on the CDA R2 document repository to provide support to the contingency plan, *Studies In Health Technology And Informatics* **216** (2015), 173-177.

[10] D.R. Sittig, D. Gonzalez, H. Singh, Contingency planning for electronic health record-based care continuity: a survey of recommended practices, *International Journal of Medical Informatics,* **83**(11) (2014), 797-804.