Innovation in Applied Nursing Informatics
G. Strudwick et al. (Eds.)

doi:10.3233/SHTI240105

Efficient Workflow Analysis to Address Paper Persistence in Tuberculin Testing

Sarah A THOMPSON[a,1], Eli DAWSON[a], Swaminathan KANDSWAMY[b], and Evan ORENSTEIN[a,b]
[a] *Children's Healthcare of Atlanta, Atlanta, GA*
[b] *Emory University School of Medicine, Atlanta, GA*
ORCiD ID: Sarah Thompson https://orcid.org/0009-0008-6973-2919

Abstract. Despite widespread adoption and maturity, paper persistence endures in many Electronic Health Record (EHR) systems, particularly for complex workflows involving multiple steps from different stakeholders separated in time. In our health system, Latent Tuberculosis Infection (LTBI) testing was one such workflow where a Tuberculin Skin Test (TST) must be administered and then correctly read 48-72 hours later and documented. This paper discusses a low-resource workflow analysis and clinical decision support approach to replace a paper workflow and garner the benefits of the EHR for clearer documentation and retrieval of LTBI results. Our approach resulted in a significant increase in completed TST documentation, 57% (24/42) to 95% (18/19), $P < 0.003$. Human-centered design practices such as work system analysis and formative usability testing are feasible with limited resources and improve the likelihood of success of electronic workflows by designing solutions that fit existing clinical workflows and automating processes wherever possible.

Keywords. Electronic health records, nurse documentation, workflow evaluation, redesign, paper persistence

1. Introduction

Widespread adoption of Electronic Healthcare Records (EHR) in the United States was precipitated by the passing of the Health Information Technology for Economic and Clinical Health (HITECH) Act into law in 2009[1]. EHR adoption promised gains in patient safety, quality of care, efficiency, and reduced costs[2]. As of 2021, 96% of hospitals have adopted EHRs with many of these hospitals having mature EHR systems[3]. Despite this maturity there still exists EHR workarounds and paper processes. Paper persistence endures for several reasons including preference, poor usability/function of EHR tools, time intensity to complete task, or lack of available documentation within the EHR and is more common for complex processes involving multiple stakeholders with tasks separated in time[4]. These paper processes circumvent EHR benefits and can lead to unintended adverse consequences, documentation gaps, impaired communication, and ultimately result in harm to patients.

[1] Corresponding Author: Sarah A Thompson, sarah.thompson2@choa.org

Our hospital adopted a corporate vendor EHR system in 2004 (Epic Systems©). Despite the maturity of the current system, there still exists paper persistence with several workflows. Continued adoption of all lingering nonemergency, non-downtime paper processes to electronic is slow due to perceived concerns around project effort and ease of user adoption. Published best practices for electronification of existing paper processes include performing workflow process mapping, user centered design and usability testing of new interfaces[5–7]. However, performing all these tasks rigorously can require substantial resources that are often unavailable. The aim of this paper is to demonstrate an efficient, feasible process for workflow analysis and usability resulting in a successful transition from paper/electronic hybrid documentation to fully electronic documentation using the case of Tuberculin skin testing (TST).

2. Methods

2.1. Setting

This intervention was conducted at a large tertiary pediatric health system with three free-standing children's hospitals specific to inpatient admissions.

2.2. Problem Identification

Providers were not compliant with existing system policies and best practices of ordering TST prior to solid organ transplantation or certain classes of biologics. At baseline, TST documentation was a mixture of electronic and paper documentation making it challenging to support TST ordering with clinical decision support (CDS). Nurses were using workarounds of documentation of TST interpretation time on an editable "sticky note" and verbal report from shift to shift. Providers had to create a note specifically documenting results for pharmacy as the paper form with results was not scanned until a patient was discharged. Even if the paper was scanned appropriately, many providers did not know how to find the result for appropriate decision-making. A small clinical informatics team including a pharmacist and nurse, reviewed the existing workflows and documentation processes mapping out users, tasks, and locations associated with TST.

2.3. EHR Design

A nurse and pharmacy informaticist performed a workflow analysis through three short focus groups with nurse and provider stakeholders and analyzed existing EHR and paper artifacts to understand current documentation practices. They then created a process map using a swimlane workflow diagram to identify users and tasks that required electronic support. These findings were used to inform a candidate EHR design for subsequent usability testing.

2.4. Formative Usability

Formative usability testing was done for each design. Participants were recruited at the point of clinical care (*in situ*) for an estimated 5–10-minute assessment. We presented standardized scenarios to participants and asked them to "think-aloud" as they completed scenarios in a test version of the EHR under observation by the design team. At the end of each session, feedback was obtained on design which was iteratively incorporated to improve design between participants. Peer checking of notes was done to ensure validity of documentation.

2.5. Outcome evaluation

Inpatient admissions that received a TST were identified using an embedded EHR data tool. Manual chart review was conducted to compare the pre- (7/01/2023 – 10/10/2023) and post- (10/11/2023 – 11/30/2023) intervention period. Documentation was classified into four types: (1) Complete documentation in which the patient had both administration and interpretation documented and in the electronic chart, (2) Incomplete documentation in which documentation was in the chart but missing the interpretation result, (3) Discharged prior to reading in which the patient was discharged prior to the appropriate interpretation period, and (4) No documentation in chart.

3. Results

3.1. EHR Design

The initial TST administration documentation was done starting from the electronic Medication Administration Record (eMAR) workflow. To reduce the need to educate, we aligned the new workflow to begin with the eMAR for TST interpretation documentation as well. The initial TST eMAR order would have an associated "dummy" medication order that was scheduled 52 hours from order placement. That time period was chosen to allow sufficient time for nurses to obtain and administer the TST while staying within the 48-72 hour interpretation window. The eMAR order is time adjustable after initial ordering. The dummy medication order allows nurses to document interpretation directly from the eMAR and auto-populates the result information in the lab results review section of the EHR. In addition, a report is auto-generated with the administration of the TST and the result from interpretation is auto-populated. This report is printed with discharge paperwork and automatically saved in the electronic chart. Non-nursing providers do not typically access the eMAR or other flowsheet documentation, so to help support their potential TST interpretation documentation, a non-interruptive alert was built to appear only during the appropriate TST interpretation period with direct links to the appropriate documentation fields.

3.2. Formative Usability

Nurse Documentation of TST Results: There were a total of 6 participants with each participant completing one scenario. All participants were able to easily complete the

documentation. All participants liked the eMAR based charting as it aligned with their current workflow and the ability to view the results in the results report. Based on feedback, no additional user testing was felt to be needed.

Provider Notification of Readiness for TST Read: There were a total of three participants (1 Advanced Practice Provider, 2 MD) and none of them perceived the non-interruptive alert indicating a need for documentation. Once directed to the alert, they felt that it was appropriate and did allow for easy documentation. Minor changes were made to the picture within the alert that helped with TST interpretation based on provider feedback. Although the providers did not perceive the non-interruptive alert it was felt appropriate to still move forward with this build compared to an interruptive approach.

3.3. Outcome evaluation:

In the pre-intervention review period 44 TST were administered; 24/44 (55%) had complete documentation, 7/44 (16%) had incomplete documentation, 2/44 (5 %) were discharged prior to interpretation period, and 12/44 (27%) had no scanned documentation. Post implementation 26 TST tests were administered; 18/26 (69%) had complete documentation, 1/26 (4%) had incomplete documentation, 7/26 (27%) were discharged prior to interpretation period. Comparing tests without discharge prior to the intervention period, the proportion with complete documentation increased significantly from 57% (24/42) to 95% (18/19), $P < 0.003$.

4. Discussion

The transition from a hybrid TST documentation state to a fully electronic one for inpatient admissions has increased completed documentation of TST results. The automation of generating a TST interpretation report ensures that documentation exists clearly in the chart, thus eliminating the issue of no scanned documentation and improving result availability. In addition to improving documentation completeness, this design strategy reduces overall documentation burden on providers who no longer need to write additional notes and information retrieval time for providers and pharmacists having to search the chart for results. The incorporation of the documentation reminder on the eMAR prevents nurses from having to use workarounds to remember the period for checking the site. In addition, the embedded flowsheets allow them to do all the tasks within one screen. The nurses also have reduced documentation due to the automation of both the interpretation and automatic report generation. Electronic documentation also allows us to solve the original reason for the design change by helping to support targeted, accurate CDS for TST testing. In the absence of electronic documentation, CDS systems could not appropriately suppress if in fact TSTs had been performed prior to solid organ transplantation or biologic medication orders.

Transitioning from paper to electronic workflows requires more than simply taking the piece of paper and making an electronic version. We employed a combination of workflow analysis and human-centered design techniques to inform the EHR design that led to improvements. To make these techniques feasible in an operational context, we made important compromises to preserve each method's utility while minimizing resource requirements. For example, in the workflow analysis, our team did not

perform interviews or focus groups until thematic saturation – rather we used a combination of interviews and observations to gain enough insight to create a swimlane workflow diagram and describe user roles and tasks. Similarly, for formative usability we did not recruit participants to a usability lab, record sessions, or transcribe interviews. Rather, we used *in situ* techniques, identifying prospective users working clinically who could participate. In addition to accelerating recruitment and limiting the time requirements for the design team, this approach also provided higher fidelity environments as our simulations were completed in the exact contexts where they would later be used, increasing our understanding of how users genuinely interact and use the EHR to deliver patient care. Thoughtfully incorporating new workflow into existing ones increases the chance of compliance and success[8]. This attention to understanding work-as-done has allowed successful adoption.

This study is limited as it was performed in a single health system with specific existing workflows and culture around TSTs. Additionally, there remains a significant gap for patients who are discharged prior to the interpretation period that continues to require paper workflows when expanding beyond the inpatient context. This gap will likely persist for some time related to (1) lack of technical interoperability between the hospital EHR and the interpreting community providers' EHR systems and (2) the technical and social lift to allow for patient entered data. It is part of our future work to move towards allowing patients and family to document TST interpretation through a patient portal.

5. Conclusions

Addressing lingering paper persistence for non-emergent, non-downtime procedures in a mature EHR system is feasible and recommended to avoid unintended consequences of hybrid documentation. Human-centered design practices such as work system analysis and formative usability testing are feasible with limited resources and improve the likelihood of success of electronic workflows by designing solutions that fit existing clinical workflows and automating processes wherever possible. Successful transition can help to reduce documentation burden and support implementation of CDS to support safer patient care.

References

[1] The American Recovery and Reinvestment Act of 2009. Public Law 111-5-February 17,2009. Pg. 227. https://www.govinfo.gov/content/pkg/PLAW-111publ5/pdf/PLAW-111publ5.pdf

[2] Menachemi N, Collum TH. Benefits and drawbacks of electronic health record systems. Risk management and healthcare policy. 2011 May 11:47-55. doi:10.2147/RMHP.S12985.

[3] Adoption of Electronic Health Records by Hospital Service Type 2019-2021 | HealthIT.gov, (n.d.). https://www.healthit.gov/data/quickstats/adoption-electronic-health-records-hospital-service-type-2019-2021

[4] Fraczkowski D, Matson J, Lopez KD. Nurse workarounds in the electronic health record: an integrative review. Journal of the American Medical Informatics Association. 2020 Jul;27(7):1149-65. doi:10.1093/jamia/ocaa050.

[5] Irizarry T, Barton AJ. A sociotechnical approach to successful electronic health record implementation: five best practices for clinical nurse specialists. Clinical Nurse Specialist. 2013 Nov 1;27(6):283-5. doi:10.1097/NUR.0b013e3182a872e3.

[6] Rinne ST, Brunner J, Mohr DC, Bearak AC, Anderson E. Practices Supporting Electronic Health Record Transitions: Lessons from Four US Healthcare Systems. Journal of General Internal Medicine. 2023 Oct;38(Suppl 4):1015-22. doi:10.1007/s11606-023-08279-0.

[7] Regan EA, Wang J. Realizing the value of EHR systems critical success factors. InHealth Economics and Healthcare Reform: Breakthroughs in Research and Practice 2018 (pp. 56-76). IGI Global. doi:10.4018/IJHISI.2016070101.

[8] Lindsay MR, Lytle K. Implementing best practices to redesign workflow and optimize nursing documentation in the electronic health record. Applied Clinical Informatics. 2022 May;13(03):711-9. doi:10.1055/a-1868-6431.