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Neonatal Informatics: Information Technology to Support Handoffs in Neonatal Care

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Abstract

Communication failures during physician handoffs represent a significant source of preventable adverse events. Computerized sign-out tools linked to hospital electronic medical record systems and customized for neonatal care can facilitate standardization of the handoff process and access to clinical information, thereby improving communication and reducing adverse events. It is important to note, however, that adoption of technological tools alone is not sufficient to remedy flawed communication processes.

Objectives—After completing this article, readers should be able to:

1. Identify key elements of a computerized sign-out tool.
2. Describe how an electronic tool might be customized for neonatal care.
3. Appreciate that technological tools are only one component of the handoff process they are designed to facilitate.

Introduction

Communication errors are a leading underlying cause of adverse events and patient harm, and handoffs in patient care represent one source of such errors.[1, 2, 3] The quantity and complexity of handoff information is increased in the intensive care environment, escalating the potential for errors in a process already described as a haphazard "precarious exchange".[4, 5, 6] The problem is exacerbated in the academic setting for two reasons: (1) residency work hour restrictions necessitate more frequent handoffs, increasing the risk of an incomplete or incorrect transfer of information;[7, 8, 9] and (2) handoffs are most commonly conducted between junior trainees who have not commonly been given a formal structure or training for this process.[10]

The communication issues implicated as a root cause in greater than 80% of reported sentinel events represent an opportunity for the development of technological tools designed to improve the exchange of information.[2, 11, 12] Specifically, computerized sign-out tools can facilitate standardization of the handoff process and access to clinical data.[13, 14] In doing

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so, these electronic sign-out applications have the potential to improve communication and reduce preventable adverse events.[15] The benefits of using computerized sign-out tools to facilitate the handoff process have been demonstrated in various medical disciplines[16, 17, 18] including pediatrics[19, 20] and the newborn intensive care unit (NICU).[21]

Electronic Sign-out Tools

Electronic sign-out tools can take several forms, including word processor or database manager documents, web-based systems, and tools integrated within a hospital's electronic medical record (EMR). Regardless of the sign-out system used, certain essential information should be included. Patient demographics (name, medical record number, and location) are required for patient tracking. Information such as weight, medications, allergies, pertinent laboratory data, and provider-entered patient details (e.g. a prioritized problem list, brief narrative comments) are needed to summarize a patient's clinical status and management. Information classified as either a to-do or an anticipatory guidance item is more likely to be communicated effectively,[8] so these categories should be included as well. Finally, instructions to covering colleagues and short-hand commentary that suggest ways to adapt the care plan are not typically included in progress notes and are more accessible to covering providers when aggregated in a sign-out system.

While standalone sign-out systems such as manually updated word processor documents may improve workflow over paper processes, they can contain troublesome inaccuracies due to the significant effort required to transcribe and manually update information often available electronically. It is beneficial, therefore, to combine provider-entered clinical information with data automatically populated from the EMR.[5, 22] Frank and colleagues at the Alfred I. DuPont Hospital for Children demonstrated that integration of a sign-out tool within the hospital's EMR to automate the retrieval of demographic and clinical information improved efficiency and accuracy.[19] In addition to utilizing data already present within the EMR, an EMR-integrated approach allows provider-entered sign-out information to be recorded in the EMR. Improved access to sign-out information has been shown to benefit communication by allowing the asynchronous transfer of information between members of the care team.[23] Another potential benefit of EMR-integration is the development of automated checklists that provide clinical decision support using specific patient information to promote adherence to best practice guidelines or other protocols.

Customization for Neonatal Care

When an EMR-integrated sign-out tool adopted in the medical and surgical wards at Lucile Packard Children's Hospital at Stanford failed to gain usage in the NICU,[20] Palma et al. documented the development and acceptance of a sign-out tool specific to neonatal care (Figure 1, Figure 2).[21] Following its introduction, the neonatal EMR-integrated sign-out tool was adopted rapidly, and provider satisfaction and perceptions of sign-out accuracy were improved compared to the NICU's previous standalone sign-out tool, a Microsoft Access database.

The experience at Lucile Packard Children's Hospital underscores the notion that the handoff process varies across different clinical settings.[24] In order for an electronic tool to support communication in a particular setting, it must be tailored to the needs of that area. A primary reason that the EMR-integrated medical/surgical sign-out document was not adopted in the NICU was its length: each page of the printed document contained 2-3 patients, making the complete document cumbersome for rapid information retrieval in the 40-bed NICU. The neonatal sign-out tool was designed in such a way that each page includes up to 10 patients. Despite modification of the document's layout, the representation of provider-entered sign-out information within the EMR is consistent with that of the

medical/surgical sign-out. Because the information is patient-centric, when NICU patients are transferred to other units, their sign-out information automatically populates the sign-out document used in the receiving unit.

Electronic sign-out tools provide flexible layouts and alternative data views that permit powerful customization of the information contained in a sign-out document. The same system used throughout an institution can be adapted to fill the specialized needs of a neonatology service. In addition to standard demographic information, a neonatal sign-out tool should include an infant's estimated gestational age. During the first several days following birth, it might also be useful to include the time of birth to aid in management decisions such as the treatment of hyperbilirubinemia. The birth weight should also be part of the sign-out document, as it is often used for medication dosing and fluid calculations during the first 1-2 weeks after birth. Laboratory data (e.g. total bilirubin levels) included on the sign-out could be annotated with the patient's age in hours when clinically appropriate. At some point, perhaps at a week after birth, automating the calculation of postmenstrual age lends context to an infant's clinical status. Whereas the medical data in sign-out systems are typically the patient's own data, for the purposes of neonatal care, including key medical details about the mother may be useful.

Beyond Technology

Although this review focuses on technological approaches to improving communication, it is important to recognize that non-technical methods must be employed to address flawed handoff processes; computerization alone is not sufficient to improve communication in the setting of a poor process.[5, 25] The process itself must be examined for communication failures, which define the steps required for improvement.[24] Several manuscripts describe methodologies for refining the handoff process,[26, 27] one of which evaluates handoffs in non-medical settings with high consequences for failure, such as nuclear power plants and the NASA Johnson Space Center.[28] Only once the handoff process has been defined can a computerized tool be designed to support it effectively.

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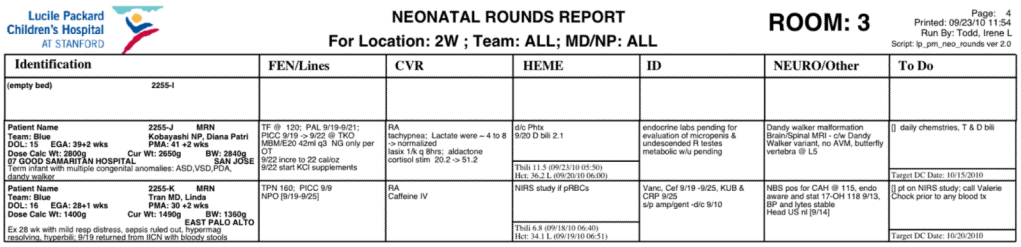
Figure 1.
Neonatology team at Lucile Packard Children's Hospital using an EMR-integrated sign-out document to facilitate communication.



Lucile Packard Children's Hospital AT STANFORD

NEONATAL ROUNDS REPORT
For Location: 2W ; Team: ALL; MD/NP: ALL

ROOM: 3

Page: 4
Printed: 09/23/10 11:54
Run By: Todd, Irene L
Script: lp_pm_neo_rounds ver 2.0

Identification	FEN/Lines	CVR	HEME	ID	NEURO/Other	To Do
(empty bed) 2255-I						
Patient Name 2255-J MRN Team: Blue Kobayashi NP, Diana Patri DOL: 15 EGA: 39+2 wks PMA: 41 +2 wks Dose Calc Wt: 2800g Cur Wt: 2650g BW: 2840g 07 GOOD SAMARITAN HOSPITAL SAN JOSE Term infant with multiple congenital anomalies: ASD,VSD,PDA, dandy walker	TF @ 120; PAL 9/19-9/21; PICC 9/19 -> 9/22 @ TKO MBM/E20 42ml q3 NG only per OT 9/22 incre to 22 cal/oz 9/22 start KCl supplements	RA tachypnea; Lactate were – 4 to 8 -> normalized lasix 1/k q 8hrs; aldactone cortisol stim 20.2 -> 51.2	d/c Phtx 9/20 D bili 2.1 Tbili 11.5 (09/23/10 05:50) Hct: 36.2 L (09/20/10 06:00)	endocrine labs pending for evaluation of micropenis & undescended R testes metabolic w/u pending	Dandy walker malformation Brain/Spinal MRI - c/w Dandy Walker variant, no AVM, butterfly vertebra @ L5	[] daily chemstries, T & D bili Target DC Date: 10/15/2010
Patient Name 2255-K MRN Team: Blue Tran MD, Linda DOL: 16 EGA: 28+1 wks PMA: 30 +2 wks Dose Calc Wt: 1400g Cur Wt: 1490g BW: 1360g EAST PALO ALTO Ex 28 wk with mild resp distress, sepsis ruled out, hypermag resolving, hyperbili; 9/19 returned from IICN with bloody stools	TPN 160; PICC 9/9 NPO [9/19-9/25]	RA Caffeine IV	NIRS study if pRBCs Tbili 6.8 (09/18/10 06:40) Hct: 34.1 L (09/19/10 06:51)	Vanc, Cef 9/19 -9/25, KUB & CRP 9/25 s/p amp/gent -d/c 9/10	NBS pos for CAH @ 115, endo aware and stat 17-OH 118 9/13, BP and lytes stable Head US nl [9/14]	[] pt on NIRS study; call Valerie Chock prior to any blood tx Target DC Date: 10/20/2010

Figure 2.
Sample of an EMR-integrated neonatal sign-out document.