

Processes and support tools for interhospital neonatal patient transfer: A preliminary study

Anne Miller, Laurie Novak, Matt Weinger, Peter Buerhaus
Vanderbilt University Medical Center,
Nashville, Tennessee

There has been a growing interest in interhospital patient transfers. However, much of this research has focussed on the criteria for transferring patients; very little research is available about the transfer process itself. The purpose of this preliminary study was to describe the process and support technology used to transfer neonatal intensive care patients from metropolitan and rural hospitals to Vanderbilt Children's Hospital (VCH). Three patient transfer events were observed using ethnographic observational methods. One researcher observed processes at VCH while a second researcher accompanied the transport team. Data from both perspectives were collated and integrated. The resulting process model shows that patient transfers are complex, highly choreographed processes involving three leaders. Multiple modes of technology are used for very different purposes. Areas of potential vulnerability include leader inexperience, the use of paper forms by multiple leaders and complexities associated with the convergence of parallel processes. Directions for future research are suggested.

INTRODUCTION

Transitions occur when patient care is transferred from person to person (e.g. nurse shift handovers), from department to department (e.g. emergency department to a hospital ward; operating room to the intensive care unit) and from one hospital to another. Although the literature is currently sparse, interest in hospital-hospital patient transfers is growing. Recent research suggests that patient outcomes (mortality and morbidity) are affected by hospital-hospital transfers (Smith et al 2005; Wong & Levy 2005; Ligtenberg et al 2005; Barry & Ralston, 1994) but there is very little research associated with the transfer process itself: who is involved, how, when and by what means.

In their study, Ligtenberg et al (2005) found that adverse events were associated with 34% of interhospital transfers. Of these, 50% were attributed to recommendations by admitting physicians not being followed with 30% attributed to technical problems. These findings are consistent with earlier research by Barry and Ralston (1994) who identified inexperienced staff and inadequate and malfunctioning equipment as critical problems during patient transport and advocated specially trained paediatric transport teams to reduce adverse events. Wong and Levy, (2005) noted that systemic issues including time delays and inadequate transport processes were associated with increased patient mortality. Smith et al (2005) developed and evaluated a set of practice guidelines that were designed to ensure that appropriate patients are transferred but the guidelines also offer some advice about aspects of the transfer process. The guideline evaluation was, however, inconclusive and further research was recommended.

Still less research is available about information technology needs during patient transfers. McGrow et al (2004) and recent initiatives such as SBAR (Situation, Background, Assessment, Recommendations) (Haig et al, 2006) are notable exceptions. McGrow et al (2004) report observations after the implementation of an augmented global positioning system, but without prior or baseline data, post-implementation observations could not be compared. Similarly, SBAR protocols have yet to be empirically evaluated.

Rather than focus on fragmented aspects of patient transfers e.g. technology, people or processes, the purpose of this study was to describe neonatal transfers from metropolitan and rural hospitals to Vanderbilt Children's Hospital (VCH), Neonatal Intensive Care Unit (NICU) as an integrated socio-technical process.

METHOD

Participants

Following ethics committee and other relevant approvals (e.g. transportation services), a convenient sample of three neonatal patients, three transport teams and three VCH NICU teams agreed to participate in this study. Two of the neonates were located in metropolitan hospitals within 30 minutes ambulance drive and one neonate was located in a small rural hospital two hours ambulance drive from VCH. Two of the patients were critically ill and one patient was transferred for elective heart surgery. A driver, a transport nurse, and a neonatal nurse practitioner comprised each transport team. All staff members had undertaken specialist training in neonatal patient care and transportation and participated only once in the study. Each VCH NICU team included a fellow, a charge nurse, at least one bedside nurse and a medical receptionist. All participated only once except a medical receptionist who participated twice.

Materials

Materials included notebooks used by the researchers to document the transfer process and folders to keep collected paper-based artefacts (blank forms or checklists) used by the transport and VCH team members. The information collected in the notebooks included the time of activities, the roles of people participating in the process, the information flows and task activities and any additional observations or comments made by the researchers.

Procedure

Observations were made between 0700hrs and 1900hrs from Monday to Friday in one week in July 2007. Following notification of a potential transfer, the neonatal nurse practitioner contacted the researchers. One researcher stayed with the VCH NICU team and one researcher went in the ambulance with the transport team. One researcher went with the transport team twice and stayed with the NICU team once

and vice versa for the other researcher. The researcher travelling with the transport team recorded the transfer process from this team’s perspective. The transport team members stayed in close proximity to one another during the transport process and so it was easy for the researcher to follow the team processes and to interrupt team members to ask questions about what they were doing and why. The substantive content of participants’ responses and of conversations between team members and others involved in the transfer process were summarised and noted along with the time of activities and the roles of the people involved. The researcher who stayed with the VCH NICU team used a similar process. Although VCH team members tended to be more spatially distributed and therefore more difficult to follow as a team, activities tended to be linearly sequenced thus the process could be followed ‘as the baton’ was passed from one individual to another. Both researchers collected paper-based forms and other artefacts. Blank forms or de-identified copies were annotated to reflect the reasons for the artefact’s use by different role-holders and any other comments about the artefact thought useful by the researcher.

After the observation period, the researchers pooled their notes for all three transfers and represented the transfer process in flow-diagrams using Visio. The overall process was annotated according to roles and any other observations arising from the researchers’ notes and as a consequence of discussion during the collation process.

RESULTS

The findings from the collated observations are presented in the following three sections.

1. Transfer process overview

The overall neonatal transfer process is made up of four discrete phases: 1. a divergent activation phase, 2. parallel retrieval and 3. preparation phases and 4. a convergent reception phase (see Figure 1).

The *activation phase* begins with initial contact from the transferring physician. Initial contact may occur informally by contact between the transferring physician and the NICU fellow directly. Some of these calls become simple professional consultations and no further action is taken. If the NICU fellow believes that a transfer may be warranted then

the transferring physician is referred to the centralised bed Access Centre to make a formal request for transfer.

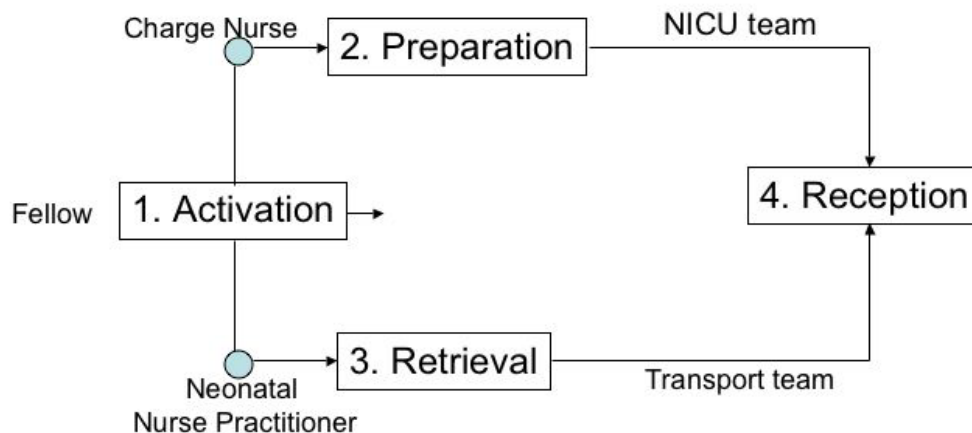
Alternatively, transferring physicians contact the Access Centre directly to request the transfer. The Access Centre then confirms the NICU fellow’s willingness to accept the patient. Prior to accepting the transfer, the fellow speaks to the charge nurse to determine the bed status. Once the patient is formally accepted the Access Centre sends out a mass page message to the transport team, the fellow, the attending, and the charge nurse to inform them that a patient has been accepted for transfer.

As information about the patient becomes available, the NICU fellow completes the Fellow’s Referral/Consultation Log, which acts as an interim patient summary, copies and distributes it to the charge nurse, the neonatal nurse practitioner (NNP) in the transport team and to the medical receptionist. The charge nurse begins the preparation phase and the NNP prepares for the retrieval phase. Meanwhile the medical receptionist sets up the patient account. Faxes sent by the medical receptionist to and from the discharging hospital provide further demographic and personal information (e.g. insurance coverage). The retrieval and preparation phases occur in parallel.

The *retrieval process* involves collecting the neonate from the discharging hospital and is managed by the transport team. Upon arrival and the transferring hospital, the transport team takes a transport crib to the unit or nursery. The NNP receives a verbal handover and the paper medical report and history from the baby’s nurse. The NNP does a full physical assessment of the baby and seeks ‘consent to transfer’ from the baby’s parents. The NNP may call the VCH NICU fellow if there is any uncertainty about the baby’s condition. Meanwhile, the transport nurse transfers the baby from the hospital to the transport crib. The baby appears to be considered by the transport team and by the discharging team to be the responsibility of the transport team as soon as the transport team arrive.

The baby is then loaded into the ambulance and secured for the return trip to the VCH NICU. Depending on how far away the discharging hospital is, the NNP will call in to Flight Communications approximately every 30 minutes to report the

Figure 1. Phases of the neonatal transfer process with team responsibilities



ambulance's location. After leaving the discharging hospital and prior to arrival at VCH, the NNP sends a detailed text message to the charge nurse reporting the baby's state and equipment needs. The NNP also sends a text message to the fellow with the expected time of arrival and then calls the medical receptionist 10 minutes prior to arrival.

The preparation phase occurs in the VCH NICU, concurrently with the retrieval phase and is coordinated by the charge nurse. The charge nurse is responsible for the NICU environment in terms of resource allocation and use. The new transfer provides an opportunity for the charge nurse to reassess and relocate babies in the NICU. A number of factors are considered in relocation, including the babies' ages, current states, prognoses and disposition relative to other babies, the family situation and nursing workloads both in the current shift and for the next two shifts.

The charge nurse then organizes the moves and prepares a bed for the new baby. This involves contacting Environmental Services to ensure that rooms are clean, and equipment specialists for beds, ventilators and other equipment. The bedside nurse who will care for the transferred baby requires forewarning so that the needs of other babies can be accommodated and so that nurses can take breaks if necessary.

The charge nurse does not know what the actual state of the transfer baby is or what the baby's needs are until the detailed voice message arrives from the NNP as they are leaving the external hospital. Much of the final preparation for the transferred baby occurs within about 10 minutes of the baby's arrival. Activities early in the preparation phase are typically more general and often inferred from scant information such as the baby's diagnosis and gestational age. A baby who is 12 weeks premature, for example, may require a different crib compared to a full term baby. Specific equipment or special needs can only be arranged when a detailed report is made by the NNP. For transfers within 10-minute drive of VCH this may leave very little time. Also during the preparation phase and once the baby's account has been set up in the computer systems residents enter standard laboratory tests and basic care orders. These may be refined closer to the time of arrival as more information becomes available.

The reception phase involves handing over the transferred baby from the transport to the VCH NICU team. At this point the parallel retrieval and preparation phases converge. Convergence begins with the '10-minute' to arrival call from the NNP to the medical receptionist. The medical receptionist informs the charge nurse and the bedside nurse of the arrival time and may inform the resident and fellow if they are immediately available.

The charge nurse and bedside nurse do a final check of the transferred baby's room and deal with any last minute issues. The transport team arrives with the baby and is directed to the baby's room by the medical receptionist. The reception workload naturally divides into two parallel streams. The transport nurse and the baby's receiving nurse physically transfer the baby from the transport crib to the baby's bed. This involves changing monitors, possibly

infusion pumps and oxygen delivery/ventilation equipment. The bedside nurse does a detailed physical examination. Concurrently, and usually in the same room, the NNP gives a report to the fellow and the resident who have arrived at the bedside. The NNP also leaves the baby's history with the physicians. The transport team departs and the NICU team settles the baby and the baby's parents if present.

2. Leader roles

Leaders coordinate activities within each of the phases but also interact with one another to ensure that parallel processes ultimately converge, thus the transfer process involves distributed collaboration. To achieve a more complete understanding of the roles of participants in collaborative work, it is helpful to look beyond domain knowledge to the strategies and types of interactions people use to coordinate their collective work. The work of linking people and processes across dimensions, such as local/global, internal/external, or across departments in an organization is called articulation work (Strauss, 1985) Articulation work requires logistical and social skills such as planning, negotiation, and achieving an understanding of other groups' perspectives. In the context of transfers, several roles involve significant articulation among distinct fields.

In preparing for the baby's arrival, the charge nurse articulates multiple internal VCH departments to arrange for the equipment, staff and other resources the baby that the NICU needs to function efficiently and effectively. This is all done using clinical knowledge about the management of critically ill neonates and experiential knowledge acquired about the organization (where resources are; and who to ask for them).

The NNP and the rest of the transfer team interact with the community and the external hospital to understand the factors that are relevant to the clinical management of the baby. On one observed transfer, for example, the NNP needed an understanding of prenatal practices in a particular cultural group (Amish). Through her experience working at the hospital-community interface she had this understanding and was able to share it with the fellow.

The medical receptionist works between the external hospital and VCH bureaucracies to establish an account for the baby and enable a smooth transition to VCH technology systems. The fellow appears to engage in fewer activities that would be characterized as "articulation". Consulting to external physicians and advising Flight Communications are examples of articulation work but for the remainder of the transfer, the fellow functions as the clinical expert and reference point for medical knowledge in neonatology.

3. Transferring information: the role of technology

During NICU transfers information transfer occurs in the following four ways:

1. Face-to-face information transfer. Face-to-face communication marks official transitions in patient care; the handover of responsibility from the discharging hospital to the transport team and from the transport team to the VCH NICU team. Handovers are generally semi-structured, though this is not always apparent to discharging staff especially when external transfers are not routine for them. Typically, the

content of handovers includes: maternal and birth history, post-delivery events, the baby's current state in terms of physiological systems, equipment, test results, medications, family issues or history.

Face-to-face communication is information-rich, including non-verbal as well as verbal communication. Through non-verbal cues, speakers gain information that can suggest comprehension as well as uncertainty on the part of either speaker or listener(s). Face-to-face communication also provides opportunity for the peripheral participation of others (parents, nurses, residents) who while not directly involved in the conversation can still hear content and interrupt as needed. All participants are able to clarify uncertainties directly and communication can be supported by visual or auditory inspection e.g. to show receiving providers some aspect of the baby and/or the equipment.

Face-to-face communication is, however, transient, unrecorded and subject to distortion, omission, misrepresentation and misinterpretation. Verbal communication is made more effective when it is supported by documentation that structures the handover. Forms or check sheets such as SBAR protocol and worksheet (Haig et al 2006) that structure verbal communication may also lubricate social processes by setting expectations about what the content of presented information should be. This in turn improves efficiency, as required information is available when it is needed. The Fellow's Referral /Consultation log currently fulfils this role. However, information documentation can be idiosyncratic: individuals may focus on completing different parts of the forms and may use different and non-standard terms and symbols.

2 Synchronous remote communication. Synchronous, remote communication involves at least two people talking to one another from different locations at the same time usually by either fixed or mobile telephones. Telephony-based conversations last between 30 seconds to no more than 5 minutes and were used to deal with uncertainties that need to be resolved before subsequent actions are taken. The discharging physician, for example, is uncertain about whether a baby should be transferred; the nurse practitioner is unclear about some aspect of a baby's care and wants clarification; the VCH NICU fellow wants to follow up with the discharging physician about test results especially if the baby is at some distance from the VCH NICU.

Other telephony-based conversations are routine parts of standard processes. Gate-keeping conversations seek approval for a process to move forward. The fellow or attending must accept a baby before the transport team can be mobilized by the Flight Communications; if a baby's parents are not present, then consent to transfer the baby must be taken over the phone. These types of conversations act as alignment points in the transfer process.

Two types of mobile telephony are used while babies are in transit: 1) personal hand-held cellular phones and 2) the ambulance 'radio' system that gives the transport team direct access to Flight Communications. In general, staff tend to use their own cell phones because the phone's menu

structure is more familiar and individuals can customize and maintain their own phone number directories. The ambulance radio is used by the driver and gives immediate access to Flight Communications especially in case of emergencies. All conversations with Flight Communications are recorded, thus content can be retrieved if needed. No other telephony-based conversations are recorded verbatim, however, paper forms support some conversations.

3 Asynchronous, remote communication Asynchronous remote communications are those between people who are separated by location and time. In NICU transfers, text and voice messaging is the most common form of asynchronous communication for non-urgent and routine communications. Like mobile telephony, providers prefer to use their own cell phones because they are familiar with menu structures.

Text messaging is used by Flight Comm to notify all possible stakeholders that there is an incoming transfer. The broadcast nature of this text message is both an advantage and a disadvantage. As an advantage, multiple people are informed about the transfer, as a disadvantage multiple irrelevant text messages can lead to a high false alarm rates which in turn can lead to either habitual failure to recognize the message or failure to read it. Text messaging that is targeted to specific roles may enhance the relevance of messages.

The combined text-voice messaging used by the transport NNP and the charge nurse was a particularly innovative use of asynchronous communication. While in transit to the NICU, the transport NNP sends a voice message to the charge nurse giving details of the baby's condition, equipment and other needs and also sends a text message to say that the details have been sent. This practice means that the charge nurse (who is often in the later stages of preparing the NICU to receive the new baby) can complete what (s)he is doing before retrieving the voice message. The voice message can be retrieved multiple times, thus the charge nurse can ensure that (s)he has received and documented the recorded information accurately before passing it on to the fellow and the bedside nurse and the NNP only has to make one detailed phone call. Similarly, the NNP text messages the medical receptionist to give the estimated time to arrival.

4 Formal communication Formal or organizational communication typically occurs via paper and most often constitutes official communication; the baby's medical history, and transfer consent forms, for example. The physical act of signing and handing over paper documents is symbolic of the handover of responsibility at the external hospital and from the transport to the NICU team

Paper is flexible, portable and disposable. These characteristics make it highly useful and usable but also make paper documents vulnerable to being mixed up, confused and lost. This is particularly the case for medical receptionists who are responsible for triggering formal admission procedures. This is mostly a paper-based process. The risk of mixed up documentation is highest when multiple babies are admitted in quick succession.

CONCLUSIONS

Inter-hospital transfers are complex, tightly choreographed, multiple phase processes with

interdependencies that are coordinated by three leaders. Fellows coordinate the activation phase, charge nurses coordinate the preparation phase and nurse practitioners coordinate the retrieval phase. This functional division reduces the likelihood that any one leader is overwhelmed, allows leaders to flexibly respond to unexpected occurrences within their sphere of responsibility, facilitates anticipative behavior and contributes to the robustness of the transfer process.

The technological supports for communication are used to align and adjust the timing of activities. Importantly, multiple modes of communication are used but each for different purposes. Face-to-face communication marks the formal transfer of responsibility. Text messaging allows simple messages to be distributed to an extended audience. Voice messaging is used to transfer detailed but highly factual information that requires high levels of accuracy. Telephone calls are used to resolve uncertainty.

Anecdotally, participants appeared to interpret the importance of messages by the mode in which the message was delivered, actions related to text messages could be deferred whereas a phone call needed a timely response.

During the observation period we observed no significant adverse events. We can, however, foresee some areas of potential vulnerability. NICU fellows, for example, have a limited tenure in the unit and may take some time before they can perceive the nature and direction of interdependencies in the transfer process. It is important, for example, that the fellow consults charge nurses about bed status prior to accepting a patient. It is also important that the fellow copies their initial notes recorded on the Fellows Referral/Consultant Log and distributes this to the charge nurse and medical receptionist as a trigger for further preparation. The broadcast text message to all relevant stakeholders from the Access Center acts as a backup triggering mechanism. In contrast to relatively inexperienced fellows, charge nurses and nurse practitioners have a much longer tenure in the NICU and use their extended past experience to anticipate needs and to make decisions about resources and the timing of activities.

Although there is a tendency to move away from paper-based systems, paper still has a useful purpose. The Fellows Consultation/Referral Log is important for capturing and distributing initial information. Its overall design does not fit the natural flow of conversations and information can be difficult to find, thus information may not be collected and may be written in idiosyncratic ways. SBAR tools may provide an alternative framework for information capture. However, distributed to the charge nurse and medical receptionist the information included on the fellow's Log rapidly diverges as individuals acquire different types of information. The extent to which this is important or problematic remains to be investigated.

Finally the effective convergence of the preparation and retrieval phases on the acceptance phase is arguably the most high-risk part of this process. Convergence depends on the effective timing of activities and the appropriate use of communication technology.

Future directions and conclusion

This was a preliminary study aimed at providing a broad, snapshot of what is a complex process. It suggests three directions for future research.

Critical incident databases can be reviewed to determine whether vulnerabilities associated with the convergence of parallel processes and with divergent information have led to adverse events in the past. In addition, non-routine or surprising events (Weinger, 2001) may also indicate areas of potential process or communication failure.

This study focussed on the transfer process overall and did not focus on what now seem to be complex patterns of information sharing and flow. Further investigation related to information flow and technology use is needed.

Finally, anticipation, the ability to foresee contingencies and to plan activities in advance, is fundamental to the leaders' roles. This aspect of adaptive human performance is poorly understood and as a consequence may be poorly supported. Clinicians' responses to non-routine events may provide insights into adaptive human capabilities

In conclusion, the complexity of inter-hospital transfer processes requires an integrated socio-technical approach to intervention implementation if adverse outcomes are to be reduced.

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