

IMPROVING PROVIDER HANDOFF IN THE NEONATAL INTENSIVE CARE UNIT

Doctor of Nursing Practice Project
Presented to the Faculty of Sinclair School of Nursing
Graduate Studies
University of Missouri

In Partial Fulfillment
of the Requirements for the Degree
Doctor of Nursing Practice
by
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Background and Significance

In a hospital setting thousands of patient handoffs occur between providers every day. It is estimated in teaching hospitals that over 4,000 handoffs occur daily (Joint Commission, 2017). Interruptions and distractions during time of handoff can increase the risk for miscommunication which can lead to patient safety risks. Elements of handoff such as noisy environments, interruptions, and verbal or handwritten handoff tools not only impact provider time and satisfaction, but also patient care, and can potentially contribute to medical errors. Medical errors in the neonatal intensive care unit (NICU) can result in significant costs, both for the healthcare system as well as for patients and their families. In one NICU alone an estimated cost of all medication errors annually was over \$168,000 (Basil et al., 2024). These costs stem from increased length of stay, additional treatments, readmissions, and long-term health consequences. Furthermore, the potential for severe harm or death due to errors can lead to significant emotional and financial burdens. Overall, the cost of medical errors in the NICU is substantial and can impact various aspects of healthcare, including financial resources, patient outcomes, and family well-being. Reducing these errors through improved communication during provider handoff is crucial for improving the quality and cost-effectiveness of neonatal care.

Statement of Purpose, PICOT, and Objective

At Mercy Hospital in St. Louis the average daily census in the NICU is around 75 infants. Twice daily provider handoff occurs on the infants that are assigned to the critical care teams. On average 30 infants in the NICU are deemed critical care, this yields 60 handoffs per day on critical care infants, 60 opportunities to ensure high level care, but consequently also 60 opportunities to provide false information, omit pertinent information, or fail to hear necessary details.

The purpose of this quality improvement (QI) project is to create an electronic medical record (EMR) generated handoff tool and implement a new standard process for provider handoff to address noise and interruptions. Providers are defined as neonatologists and neonatal nurse practitioners. Implementing the ordered discussion of the following topics: illness severity, patient summary, action list, situational awareness and contingency planning, and synthesis by receiver, known as I-PASS, is one potential method for improving the verbal component of handoff. The PICOT question related to this purpose is: In a large NICU (P) how does a standardized NICU provider handoff program (I) as compared to the current process (C) affect patient safety and provider satisfaction (O) over a period of three months (T)? The objectives are:

1. To reduce the provider time spent creating handoff sheets for each patient by 10%.
2. To reduce errors on the handoff tool by 5%.
3. To increase provider satisfaction related to ease of generating handoff tool and increased time available for other patient care activities or rest by 5%.

Review of the Literature

A comprehensive literature review was completed regarding handoff in the NICU. Electronic databases used to conduct this literature review were PubMed, SCOPUS, EBSCO, and the University of Missouri Library System. Predefined inclusion criteria included studies in the USA and English language. MeSH terms include handoff and neonatal intensive care unit. General search terms included: NICU, handoff, signout, electronic health record, and electronic medical record. Backward reference tracking was utilized to trace the origins and development of ideas. A total of 126 articles met inclusion criteria and 10 were included in the final review.

Three themes emerged from the literature search: barriers to handoff, methods to overcome those barriers and interventions to improve handoffs.

Barriers to Handoffs

Three studies addressed barriers to effective handoff which included a paucity of NICU specific studies, challenges in quantifying errors directly related to handoff, and the wide variety of location-based factors for handoff including personnel involved and their prior handoff training, size of unit, and intensity of care provided (Mardis et al., 2017; Starmer et al., 2014; Tam et al., 2018). These barriers created challenges to collect comparable data between sites. A systematic review by Mardis et al. (2017) described these barriers while examining the relationship between handoff and patient outcomes and the challenges they present with attributing the handoff to the medical error committed. Tam et al. (2018) and Starmer et al. (2014) implemented a standardized handoff program on internal medicine units and both found relating medical errors directly to handoff to be fraught with challenges though residents were able to comply with the handoff process and complete more handoffs between shifts.

Interventions to Improve Outcomes

Verbal and Written Communication. Five studies evaluated the handoff process as a whole. After auditing the handoffs of resident physicians in a NICU, DeRienzo et al. (2014) found wide variation in the number of errors committed by residents mainly depending on the variety of experience and training of the resident. In an observational study Kaplan et al. (2023) recommend that both written, in the form of note taking, and verbal methods should be used during handoff and support the use of a tool or process to aid in better transfer and recollection of information. Improving handoff resulted in a decrease in medical errors by as much as 23% (Starmer et al., 2014). Studies have found accuracy of handwritten handoff tools to have accuracy of only 64-68% (Koo et al., 2020; Nickel et al., 2021).

Standardized Tools and Processes. Standardization of the handoff process is described in two studies. Cardona et al. (2021) developed a NICU specific variation of the I-PASS method. With this tool the study authors were able to reduce interruptions by 92%. Reducing interruptions and increasing the ability to focus along with the addition of an improved and more accurate handoff tool has the potential to improve care of critically ill infants. One study chose to look at whether or not physician interns adhered to the I-PASS method of handoff when using an EMR tool that was compatible to the I-PASS method (Zavodnick et al., 2019). The authors found that designing the EMR tool to be in a format consistent with the I-PASS verbal report style encouraged compliance to I-PASS and improved handoff duration.

Technology Integration. Three studies detail improvement in handoff after creating a tool that auto-populates with patient data from the EMR. Implementation of an EMR-based handoff tool in a quality improvement project by Koo et al. (2020) resulted in an average improvement in patient medical data accuracy from 66% to 94% after implementation of a new handoff tool. Casey, et al. (2020) performed a quality improvement project that demonstrated a significant decrease in time to prepare an auto-populated EMR handoff tool as compared to a paper tool ($p < .001$). Both demographic and medical data were improved in a quality improvement project by Nickel et al. (2020) with accuracy reaching over 99%.

Methods

The project methods are outlined below. First, the project design will be described, from the initial data collection, through intervention implementation and post-intervention data

collection, to the evaluation. Also detailed below are the setting, participants, sampling, timeline, and barriers to implementation.

Project Design. This quality improvement project consisted of implementation of a process change to the current method of preparing for and participating in handoff between shifts in a NICU. Pre- and post-implementation data was collected and analyzed.

Intervention. A new handoff tool was created using the EMR, and a new structure to verbal handoff was introduced using I-PASS. In preparation for these interventions, providers were instructed on how to create the EMR-based tool and how to use I-PASS during team meetings and with a slide show presentation distributed via email and discussed in person. to teach. During the first time period of the project the participants used the established handwritten tool and give verbal handoff as they are accustomed to with the handwritten tool as a guide. In the second time period of the project the new EMR tool replaced the handwritten tool and participants were encouraged to use I-PASS.

Setting. This project took place in the NICU at Mercy St. Louis Hospital. The NICU is a 98-bed level IV unit that is located in a children's hospital within a larger hospital. Mercy St. Louis Hospital is a 733-bed facility located in suburban St. Louis County. It is a level 1 trauma center with multiple adult and pediatric specialties available. Women's and children's services are a large part of hospital admissions with over 8,000 infants born at this hospital in fiscal year 2025.

Participants. The participants in this project are a purposive, convenience sample and consist of all members of the medical provider team in the NICU at Mercy St. Louis. Inclusion criteria are employment with Pediatrix Medical Group of Missouri, who provide staffing at Mercy St. Louis, and consists of 11 neonatologist physicians and 20 NNPs. Exclusion criteria are registered nurses (RN, staff nurses), nursing (RN to RN) handoff, or any provider handoff occurring outside of Mercy St. Louis or handoff relating to patient transfer between facilities.

Sampling. Data was obtained both before and after project implementation to measure the duration of time to create handoff tools for each patient team, the duration of time to give verbal handoff for each patient team, number of errors on the handoff tools, and provider satisfaction scores with the handoff process. Sample size calculations were made using a six-week data collection time frame and Raosoft software (Raosoft, 2004). For the time to create handoff tools a population size of 336 was used, confidence interval of 95%, margin of error of 5%, and a response distribution of 20% which yields a recommended sample size of 143 documented events. For the time to complete verbal handoff a population size of 252 was used, confidence interval of 95%, margin of error of 5% and a response distribution of 50%. This yielded a recommended sample size of 153 documented events. Sampling procedure for these was simple random sampling. For the number of errors on the tools a population size of 2,940 was used, confidence interval of 95%, margin of error 5%, and a response distribution of 20% which yield a recommended sample size of 227. Sampling procedure for this data collection was systematic random sampling due to the large sample size.

Measurement Tools and Analysis. To obtain the time duration for preparation of the handoff tool each provider used a stopwatch to measure the total time of completing handoff tool preparation for an entire critical care team. This time was then documented on a paper spreadsheet located in the provider office near to where handoff tool preparation is performed. The same procedure was asked of the providers to document the duration of verbal handoff, and documentation was completed on the same spreadsheet. Completed handoff tools remained in the

office in a secure location. These tools were audited by the primary investigator for errors in the following categories: post-menstrual age, medications, intravenous access, and feeding orders. Information on the tools was compared to information available in the EMR, and number of errors were documented on a spreadsheet. The review process occurred weekly and at completion of the study period. Data obtained from these processes were entered into Statistical Package for Social Sciences (SPSS) database. In addition, 5% of the records were used for verification of data. Provider satisfaction surveys composed using Microsoft Forms software were distributed via secure email. Results from every survey collected were entered into SPSS for analysis.

Ratio data collected by comparing data sets from pre- and post-implementation of the electronic handoff tool was analyzed using the paired samples *t*-test. Ordinal data collected from the results of pre- and post-implementation satisfaction surveys was analyzed using the Mann-Whitney rank-sum test. Nominal data was evaluated using chi-square analysis. The specific objectives of this project were measured by comparing the mean and the range of data sets both pre- and post-implementation. The investigator determined if the objectives were met by calculating the percent change in the mean value from each time period. Measures of clinical significance were calculated. Statistical significance was defined as $p \leq .05$.

Results

Of the 20 NNPs and 11 neonatologists that participated in using the handoff tools and documenting data, 13 returned the initial survey regarding use of the handwritten tool for a survey return rate of 42%, and 16 returned the completion survey regarding use of the EMR generated tool for a survey return rate of 52%.

For the initial survey, the respondents were 46% physician ($n = 6$) and 54% NNP ($n = 7$). For the completion survey, the respondents were 44% physician ($n = 7$) and 56% NNP ($n = 9$). In the initial survey, the majority of respondents had between 6-10 years of experience in the NICU (46%, $n = 6$), which was similar to the completion survey whereby 50% ($n = 8$) of respondents had 6-10 years of experience.

Duration of Handoff Tool Preparation

A paired samples *t*-test was used to evaluate the change between the handwritten times and the EMR generated tool prep times and revealed a very large, statistically significant increase in the duration of time to prepare the EMR handoff tool ($M = 36$, $SD = 17.1$) as compared to the handwritten tool ($M = 13.1$, $SD = 5.3$) ($p < .001$, $d = 17.7$).

Duration of Verbal Handoff

A paired samples *t*-test was used to evaluate for change between verbal handoff using the handwritten tool ($M = 28.2$, $SD = 12.5$) as compared to using the EMR generated tool ($M = 26.6$, $SD = 8.11$). The analysis revealed a large, but not statistically significant change ($p = .418$, $d = 14.2$). Though providers were encouraged to use I-PASS, satisfaction survey results showed that they elected not to give verbal handoff using this method. As a result, there is no data to evaluate its use and it had no impact on verbal handoff times.

Errors on Handoffs

A random sample of 240 handoff tools were evaluated for errors in documenting post-menstrual age, medications, intravenous access, and feeding orders. On the handwritten handoff tools a total of 30 errors were found, on the EMR generated tool a total of 1 error was found.

Satisfaction Survey

A satisfaction survey was sent out before and after the EMR generated tool implementation. The following topics were addressed: conditions during verbal handoff, perceived benefits of handoff tool, provider satisfaction with tool, and preferred tool overall. There were no statistically significant differences of opinion between physicians and NNPs when using the Independent Sample Mann-Whitney U Test to compare survey results for the handwritten handoff conditions ($p = .295$), provider satisfaction with the handoff tool ($p = .45$), EMR handoff conditions ($p = .29$), and provider satisfaction with the EMR tool ($p = .68$). The answer to the question of which handoff tool is preferred was decisive with 13 of the 16 respondents choosing the handwritten handoff tool (81.3%, $n = 13$).

Conclusions

The purpose of this quality improvement project was to implement an EMR generated handoff tool that was not only quicker and easier to prepare, but also more accurate, and by doing so to increase the satisfaction of the NICU providers.

- The primary objective to decrease time spent creating handoff sheets was not met, rather when changing from the handwritten tool to the EMR generated tool there was a 176% increase in the amount of preparation time.
- The secondary objective was to reduce errors on the handoff tool by 5%, which was met with a 96.7% reduction in errors when using the EMR generated handoff .
- The third objective was to increase provider satisfaction by 5%, which was not met. For the handwritten tool 61.5% of providers ($n = 8$) choose a response from neutral to very satisfied. For the EMR generated tool 31.3% of providers ($n = 5$) responded with neutral to very satisfied. This yielded a decrease in satisfaction by 49.1%.

Stakeholder Recommendations

While the EMR generated handoff did not meet the objective of increased provider satisfaction with this project, there are multiple team members who are committed to continuing the search for an EMR generated handoff tool. New templates for a handoff tool can be developed with the experience gained through this project. Working with provider team input, the technology nurse, and a physician EMR builder the next iterations of the EMR tool will be implemented and studied. The increased accuracy of the EMR tool speaks volumes to the need to continue the search. Hospital administration is also invested in continuing to search for workable versions of the EMR generated tool and has agreed to purchase 4 tablets for provider use to continue this project.

Strengths and Limitations

Strengths of this project include the remarkable decline in errors on the EMR generated handoff tool as well as the lessons learned for creation of an improved future tool. Through this project it has been proven that the EMR generated handoff tool is possible, paving the way to continue the effort to find an acceptable version for the provider group. Limitations of the project included the resistance of some participants to use of the EPIC handoff, the variation in patient acuity leading to less clinical time for learning a new process, restrictions in EPIC causing the handoff to be more challenging to implement than originally thought, and the lack adherence to I-PASS.

Appendix A

DNP D1 Form



DNP Residential Project Committee Appointment Request

Student's Name: Laura McManemy

Student's Number: 12170832

Date Submitted: _____

I request that the faculty members listed below be appointed to serve as my Residential Project committee.

Dr Jan Sherman
Name of Chair*

Jan Sherman, RN, NNP-BC, PhD
Signature, Chair of Committee

Dr Robin Harris
Member*

Robin Harris
Signature, Member

Dr Brian Moore
Member*

B. J. Moore
Signature, Member

Member*

Signature, Member

Laura McManemy
Signature of Student
*Please type or print

Miriam D. Butler, DNP, NP-C, FNP-BC
Digitally signed by Miriam D. Butler, DNP, NP-C, FNP-BC
Date: 2025.07.14 16:54:24 -05'00'
Signature of Director of DNP Program, School of Nursing

To be completed during the semester enrolled in:
N9080 Section 1 DNP Residency Project

Appendix B

DNP D-3 Form



Approval of DNP Residency Project Proposal and the Institutional Review Board Protocol

Candidate's name: McManemy, Laura Mizzou ID number: 12170832
(Last Name, First Name)
 Project Title: Improving Provider Handoff in the Neonatal Intensive Care Unit

Signatures of review members
 (Please sign full names legibly)

	Acceptable	Unacceptable
Chair: <u>Jan Sherman RN, PhD</u> <i>Jan Sherman, RN, WNP-BC, PhD</i> <small>print & sign</small>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Member: <u>Robin Harris, DNP, RN</u> <i>Robin Harris</i> <small>print & sign</small>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Member: <u>Brian Moore, DO, MPH, MSMS</u> <i>Brian Moore D.O.</i> <small>print & sign</small>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Member: _____ <small>print & sign</small>	<input type="checkbox"/>	<input type="checkbox"/>

The clinical project is:

The Program Committee has explained the decision regarding the acceptability of my project proposal.

Laura McManemy 12/2/2026
 Student Signature Date

Miriam Butler 12/4/2025
 Director, DNP Program in Nursing Date

References

Agency for Healthcare Research and Quality (2023, July). *Tool: I-PASS*.

<https://www.ahrq.gov/teamstepps-program/curriculum/communication/tools/ipass.html>

Henry Basil, J., Mohd Tahir, N. A., Menon Premakumar, C., Mhd Ali, A., Seman, Z., Ishak, S.,

See, K. C., Mohamed, M., Lee, K. Y., Ibrahim, N. A., Jegatheesan, K. V., & Mohamed

Shah, N. (2024). Clinical and economic impact of medication administration errors

among neonates in neonatal intensive care units. *PLoS ONE*, 19(7), e0305538.

<https://doi.org/10.1371/journal.pone.0305538>

Cardona, V. Q., Labadie, A., Zubrow, A., Touch, S. M., & Cooperberg, D. B. (2021). Improving

the neonatal team handoff process in a level IV NICU: Reducing interruptions and

handoff duration. *BMJ Open Quality*, 10(1). <https://doi.org/10.1136/bmjjoq-2020-001014>

Casey, M. H., Turner, B., Edwards, L., & Williams, M. (2020). Improving efficiency using

electronic medical record rounding report & sign-out report. *Journal of Pediatric Health*

Care, 34(6), 535–541. <https://doi.org/10.1016/j.pedhc.2020.06.001>

DeRienzo, C., Lenfestey, R., Horvath, M., Goldberg, R., & Ferranti, J. (2014). Neonatal

intensive care unit handoffs: a pilot study on core elements and epidemiology of

errors. *Journal of Perinatology*, 34(2), 149. <https://doi.org/10.1038/jp.2013.146>

The Joint Commission. (2017, September 12). *Sentinel event alert* (Issue 58). The Department of

Corporate Communications

Kaplan, H. C., Timpson, W., Meyers, J., Schierholz, E., Cohen, H., Fry, M., Zayack, D., Soll, R.

F., Morrow, K. A., & Edwards, E. M. (2023). Shift-to-shift handoffs in the NICU: lessons

learned from a large-scale audit. *Journal of Perinatology*, 43(12), 1468-1473–1473.

<https://doi.org/10.1038/s41372-023-01724-2>

Koo, J. K., Moyer, L., Arain, Y., & Castello, M. A. (2020). Improving accuracy of handoff by implementing an electronic health record-generated tool: an improvement project in an academic neonatal intensive care unit. *Pediatric Quality and Safety*, 5(4), E329.

<https://doi.org/10.1097/pq9.0000000000000329>

Mardis, M., Davis, J., Benningfield, B., Elliott, C., Youngstrom, M., Nelson, B., Riesenber, L. A., & Justice, E. M. (2017). Shift-to-shift handoff effects on patient safety and outcomes: a systematic review. *American Journal of Medical Quality*, 32(1), 34-42–42.

<https://doi.org/10.1177/1062860615612923>

Nickel, N., Shakeel, F., Germain, A., Machry, J., & Amin, D. (2021). Handoff standardization in the neonatal intensive care unit with an EMR-based handoff tool. *Journal of Perinatology*, 41(3), 634-640–640. <https://doi.org/10.1038/s41372-020-0740-z>

Raosoft. (2004). *Sample size calculator*. Retrieved from <http://www.raosoft.com/samplesize.html>

Starmer, A. J., Spector, N. D., Srivastava, R., West, D. C., Rosenbluth, G., Allen, A. D., Noble, E. L., Tse, L. L., Dalal, A. K., Keohane, C. A., Lipsitz, S. R., Rothschild, J. M., Wien, M. F., Yoon, C. S., Zigmont, K. R., Wilson, K. M., O'Toole, J. K., Solan, L. G., Aylor, M., ... I-PASS Study Grp. (2014). Changes in Medical Errors after Implementation of a Handoff Program. *New England Journal of Medicine*, 371(19), 1803–1812.

<https://doi.org/10.1056/NEJMsa1405556>

Tam, P., Nijjar, A. P., Fok, M., Little, C., Shingina, A., Bittman, J., Raghavan, R., & Khan, N. A.

(2018). Structured patient handoff on an internal medicine ward: A cluster randomized control trial. *PLoS ONE*, *13*(3), 1–12. <https://doi.org/10.1371/journal.pone.0195216>

0195216

Zavodnick, J., Jaffe, R., Altshuler, M., Cowan, S., Wickersham, A., & Diemer, G. (2019).

Leveraging Structural Changes in an Electronic Health Record Tool to Standardize Written Handoff. *American Journal of Medical Quality*, *34*(4), 354-359–359.

<https://doi.org/10.1177/1062860618808018>