Delivering NIPE screening: the application of human factor and quality improvement tools

The project analyses the delivery of the newborn and infant physical examination (NIPE). It aims to identify weaknesses in service delivery contributing to the human factor incidents and increased demands on the junior doctor, and to redesign the system to reduce risk, improve efficiency and reinforce resilience.

Samyar Siadati
Paediatric Specialty Trainee Doctor
Neonatal Unit, Watford General Hospital, West Hertfordshire Teaching Hospitals NHS Trust

Claudia Chetcuti Ganado
Neonatal Consultant
Neonatal Unit, Luton and Dunstable Hospital, Bedfordshire Hospitals NHS Foundation Trust
claudia.chetcutiganado@ldh.nhs.uk

Keywords

newborn and infant physical examination; quality improvement; human factors; patient safety; errors

Key points

Siadati S., Chetcuti Ganado C. Delivering NIPE screening: the application of human factor and quality improvement tools. *Infant* 2023; 19(5): 169-73.

1. Human factor and quality improvement methodologies can be combined to provide meaningful recommendations for improvement in system design.
2. This article describes how mismatch between policy and daily process operation can lead to human factor errors resulting from increased demand on healthcare staff.

Background

The newborn and infant physical examination (NIPE) screening programme is a UK wide screening examination commissioned by NHS England (NHSE).[1] The aim of the examination is to ensure timely detection of infant conditions that are time-critical, where missed opportunities lead to significant morbidity and mortality. The screening standards state that the examination should be undertaken within 72 hours of birth for all UK live births above 34 weeks' gestation. For infants born prematurely, the screening examination should be undertaken at 34 weeks of corrected gestational age.

After 2017 NHSE introduced the NIPE S4N, a web-based system that can capture all livebirths and monitor adherence to the NIPE screening standards. Quarterly reports are generated through the system and trusts are required to provide assurance. Failure to meet the standards is considered a screening incident and reportable to NHSE.

The Luton and Dunstable University Hospital has a level 3 neonatal unit and maternity service with approximately 5,000 births annually. The NIPE examination is performed by junior paediatric trainees. Junior trainees on a daytime shift are allocated to undertake all NIPE examinations on the postnatal ward for births within the previous 72 hours. Mother/infant pairs are admitted to the postnatal wards from delivery suite and timely discharge is necessary for this flow to be maintained. Delays at the postnatal ward impact delivery suite capacity. Within the postnatal ward, the mother is cared for by obstetricians and the midwifery team while care of the baby is the remit of the neonatal nursing and paediatric teams, thus creating an inherent risk of 'boundary weakness'.

Trainees allocated to postnatal ward shifts often left work two hours later than scheduled, creating the need to lengthen the daytime shift of junior trainees and employ an extra person on the weekends. Through a quality improvement initiative, the neonatal team introduced a mid-shift huddle aiming to monitor workload daily and reallocate resources to provide some help to the postnatal ward junior doctor.

The introduction of the NIPE S4N within our team highlighted significant weaknesses and this led to the need for a failsafe team to ensure we were meeting the NIPE standards.

Despite our failsafe processes and revising the rota, we continue to struggle to meet demand and often need additional junior doctors to manage the workload. We continue to see screening incidents ranging from a whole examination being missed to those where referrals are not processed or followed through. There continues to be a time lag between incidents happening and the failsafe picking it up, which poses risk. The types of incidents reported or picked up by the failsafe processes are reported in **TABLE 1**.

This assessment follows the toolkit developed by Ward et al (2010)[2] as it was

specifically designed and evaluated for a healthcare context. We used a combination of human factors and quality improvement tools including the CARe resilience model as this can be extremely powerful for improvements in health care.[3,4]

System analysis

System mapping

To understand the work system for undertaking the NIPE examination we undertook a SEIPS system analysis, which is very effective at highlighting the interaction of the various people within a task/environment/resources/organisation in a healthcare-specific framework.[5-7] The SEIPS analysis identified the junior doctor as central to the task, which led to focussing a risk analysis around the task and interactions of the junior doctor.

Hazard identification

We used SWIFT (Structured What If Technique) and STAMP (Systems-Theoretic Accident Model and Processes) hazard analysis techniques to help highlight what could go wrong and risk severity.[8] The use of STAMP was effective in looking at the hierarchy of controls that can be put in place to act as a failsafe. Through our observation and system analysis we identified barriers and facilitators that could be eliminated or adopted to further strengthen our recommendations. For example, a consultant's approachability can be a barrier if the consultant only goes to help when specifically asked but a compassionate consultant that assists with the workload is a facilitator.

The STAMP analysis highlighted weakness within our control loops, particularly the lack of a dedicated failsafe team and the time lag for failsafe processes. It identified the need for a real time failsafe process to pick up human factor cognitive challenges that could be reduced.

Understanding demand capacity mismatch

We used observation to complement our analysis and to understand 'work as done' using guidance from the NHSE Brief Guide to Conducting Observations.[9] Part of this was timing the process for undertaking the task from start to finish observing four different junior doctors. We formulated a questionnaire based on understanding how the day-to-day operation influenced completion of the task. The questionnaire explored the task, equipment, environment, information flow and impact on cognitive functioning. The findings from this survey are depicted in **FIGURE 1**.

The observation helped to understand the trade-offs performed by trainees daily. Considerable time was spent travelling to and from the nursery as the workstation was in the nursery and the hospital policies dictated that the baby needed to be

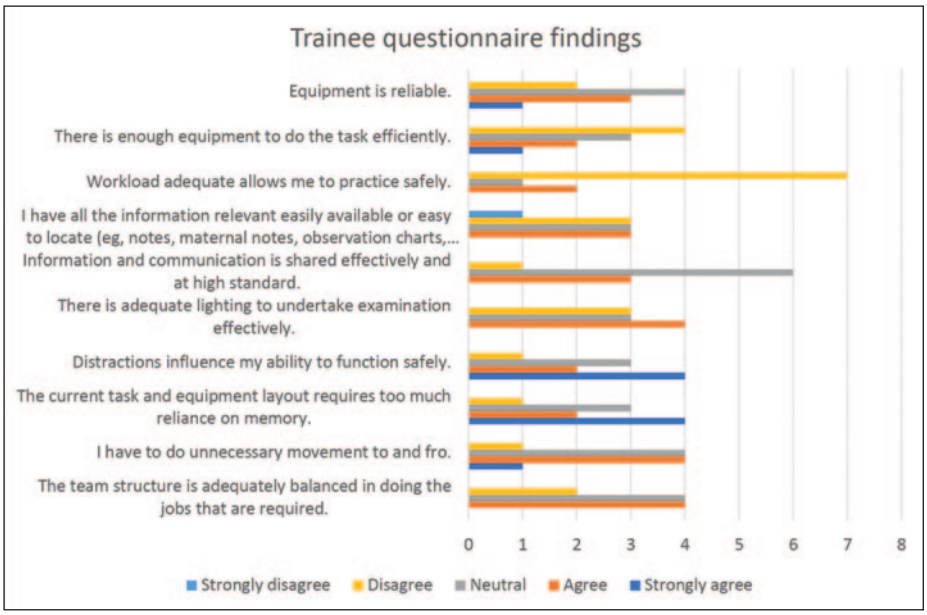

FIGURE 1 Results of a questionnaire survey of junior doctors undertaking the NIPE examination as part of their job role (n=11).

Standard	Types of incidents
NIPE examination undertaken in the first 72 hours	• Missed newborn screening • Babies with same name given the wrong paperwork and entered incorrectly on S4N • Examination undertaken and not entered onto system • Delay in the examination
Hip screen positive: should have a hip scan within 4-6 weeks	• Hip scan missed as hip scan not requested on electronic test requesting system • Hip scan delayed as not requested and picked up later by failsafe processes • Wasted hip scan appointment given to patients transferred in but out-of-area • Hip scan offered late due to clerical errors in radiology
Absent red reflexes in the eyes: should see ophthalmologist within two weeks of examination	• Delay due to wrong process followed in referral via rapid pathway • Missed referral due to early transfer of baby to another hospital for specialist treatment
Abnormal cardiac examination – should be reviewed by senior paediatrician prior to discharge	• Missed review due to failure to follow correct pathway • Reviewed but not documented on system • Referral not processed
Bilateral undescended testes – should be reviewed by a paediatric consultant within 24 hours	• Missed review due to failure to follow correct pathway • Reviewed but not documented on system • Referral not processed

TABLE 1 Types of incidents in the NIPE processes highlighted by the failsafe monthly reports generated at departmental level.

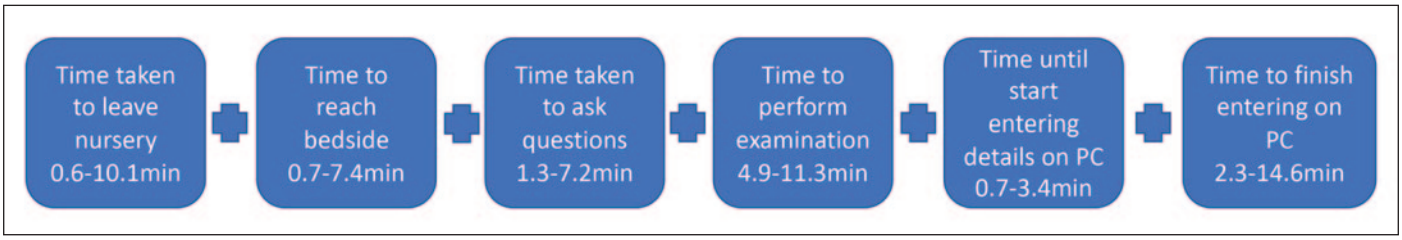

FIGURE 2 Timed observation of four trainees undertaking the task from start to finish.

examined at the bedside. Although there was a printer in the nursery, the computer was connected to an adjacent room printer. When other trainees were available to support high workload, the presence of only one computer meant that the trainees had to wait their turn to be able to use the computer. The trainee had to log in separately to the S4N and the electronic test requesting system, which further reduced productivity. On occasion, the trainee used the log in of the previous trainee to save on time, which can introduce significant medicolegal risk.

As can be observed from the timed process map, the time from start to finish can vary between 10.5 to 54 minutes with a mean of 32.3 minutes (**FIGURE 2**).

On average there are 15 examinations per day, which would require a mean of 8.1 hours. This depicts a significant demand/capacity mismatch. The doctor's duties span more than just NIPE examinations, yet the time taken to go to and from the nursery to the bedside once can take up two hours of the working day. The time to perform the examination ranges from 4.9 minutes to 11.3 minutes. If the baby is undressed and dressed by another team member while the doctor is gathering information and entering the documentation, we hypothesise that the time to undertake the examination will be reduced by half from a mean of 8.1 minutes to 4.05 minutes thus effectively saving another 60 minutes.

During busy times we noted established medical staff requesting the help of the neonatal nurse. The nurse undressed the baby while the doctor was gathering information and dressed the baby while the doctor documented the findings and made a plan. We observed that three neonatal nurses were on shift at any time who could be used more effectively. The examination can be delayed attempting manoeuvres to get the baby to open his/her eyes. Trainees needed the neonatal nurse to hold the baby's eyes open. When senior and established staff were on shift, they had no problem getting one of the neonatal nurses to support in this way but more junior and temporary staff did not feel empowered to do so. There is no clear standard operating policy around the role of the neonatal nurse. We feel that supporting this adaptation by including the neonatal nurse to support in the process, will significantly reduce the misalignment between demand and capacity and may eliminate the need to employ the neonatal doctor on a longer shift.[10-12] Early discharge of patients will improve flow and capacity and will impact safety by reducing the cognitive workload on the neonatal doctor.[13,14] The questionnaire highlighted that eight out of 11 trainees felt the workload was not conducive to safe practice.

It is evident from the timed process map that a large amount of time is spent obtaining the information and walking to the nursery. Often this is because information and equipment are misplaced, out of battery or being used by someone else. The positioning of the tools did not support the policy of examining the baby at the maternal bedside. Examining the baby and then walking to the workstation with the possibility of interruption adds to the cognitive workload and may impact on safety. Alternating between tasks while waiting for the availability of the computer further increases the likelihood of error.[13,14] Most neonatal doctors indicated that there is not enough equipment to do the job efficiently and the current task and equipment layout requires too much reliance on memory (**FIGURE 1**).

How can the work system be modified to reduce risk or improve performance?

We used the adapted HFIX (Human Factors Intervention Matrix) to make recommendations for the whole of the work system.[15] This looks at areas for improvement that can be modified to reduce risk or improve performance at the level of:

- individuals
- tasks
- tools and technology
- internal environment
- organisation
- external environment.

Our analysis yielded 13 recommendations, which can be seen in **TABLE 2**. Our recommendations detail ways of anticipating, responding to, monitoring, co-ordinating and learning.[3] Our recommendations all scored highly for feasibility, acceptability, cost effectiveness and potential to be sustained. The biggest feasibility challenge is recommendation 13, which relates to system interoperability.

Implementation, evaluation and sustainability

Many of our recommendations are centred to changes to team processes involving new ways of working and new responsibilities. Changes to the way a team functions can be very challenging – it takes time to fully embed change and often resistance is encountered from the people doing the work. Implementation can be done as plan-do-study-act (PDSA) cycles on a small-scale pilot and tested for further adaptations, acceptability, and effectiveness before implementing on a wider scale.[16] The changes in the team processes can be made in parallel or in a sequential manner.

The recommendations relating to equipment will need a business case demonstrating the cost/benefit of reduction in the work as shown by Chhokar et al (2005).[17] The capital investment will need to be compared to the cost savings over time of paying extra doctors and cost of improved flow.

For evaluation, three types of measures can be used:

Outcome measures: these consider efficiency (eg length of time it takes to undertake examinations, average length of stay of well babies or the number of babies being sent to contingency wards) and safety (eg the number of screening incidents and number of missed referrals) and the effect the new processes have on staff (eg captured through interviews or questionnaires).

Process measures: adherence to the process is best measured through observations and interviews to look at whether safety briefing, consultant check-in and handover are carried out daily.

Balancing measures: It is likely that the new process will create unexpected or undesirable outcomes, eg it may impact the nursery nurse workload.

To ensure sustainability we need to establish quality standards that are representative of process benefits. A quality control run chart (eg monthly missed referrals) could be displayed in common areas to create team awareness of benefits.[18] As with all new interventions, much work needs to be invested in changing culture through leadership, involvement, and champions.[19-21]

Conclusion

We have shown how combining human factor and quality improvement tools could complement each other to interrogate

Problem	Recommendations
1. There is no clear standard operating policy around the role of the neonatal nurse	The neonatal nurse supports the junior doctor in a process that resembles a ward-round
2. A large amount of time is spent obtaining information and equipment, and walking to the nursery	A workstation on wheels that contains all the necessary paperwork so that the doctor can reduce unnecessary trips to and from the nursery
3. Significant disruption can occur with computer malfunction. Risk is introduced when two doctors use the same log in	The postnatal ward should have two workstations on wheels to allow for malfunction and high activity
4. Experienced trainees often call the consultant using their mobile; less established staff do not feel empowered to do this or do not have the direct number	Consultants highlight their availability and ways of reaching them each morning
5. Incidents relating to the trainee forgetting to request hip scans are exacerbated by the absence of interoperability of the S4N and the electronic referral system	A process at the end of the shift where the junior trainee downloads a list of all referrals for that day from S4N and cross checks with the electronic test requesting system that these have all been requested
6. Lack of lighting is common. Doctors use their mobile phones as torches when examining babies. Suboptimal lighting may miss important pathology and there are infection control implications	Equip trainees with head torches to undertake their examination round
7. When the S4N system is down, all entries are entered on paper form, relying on the trainee to keep a list of babies and look for the notes when they are back on a shift. This can result in delay in entering data and risk of not entering babies onto the system	Establish a structured process where the failsafe team downloads a list of all babies born when there is system downtime. The failsafe team enters all data in a timely manner, cross checking the list to ensure all babies have been examined
8. Processing paper referrals involves the trainee placing them into trays that are emptied daily. But the ward clerk often forgets this task and the trays are emptied ad hoc leading to delay	We propose an end of shift checklist for mandatory daily emptying of the tray and a process for the nursery nurse to check the tray each morning (eg during safety briefing)
9. There is a printer in the nursery but the computer automatically defaults to a printer in the adjacent room, leading to unnecessary trips. When the printer malfunctions, there is no back-up printer and getting in touch with the IT team is lengthy	IT team to ensure computer defaults to the printer within the nursery Printer back up should be located close to the workstation Establish a process for reaching IT teams urgently (eg a dedicated line)
10. The notes for baby and mum often need to be accessed by both midwifery and neonatal teams, leading to notes being misplaced	Notes are kept in one bespoke trolley at the entrance of each bay
11. There is an inherent delay in failsafe. The distant geographic locations add to communication failures	Establish real time and more robust failsafe processes: junior trainees generate a daily report of referrals and cross check that all referrals have been requested; a dedicated failsafe team (including a team leader) should oversee all elements within the process; the trust should ensure that the job plan fully reflects the workload
12. The process for handover between neonatal doctor/nurse/midwife is opportunistic. The discharging midwife does not consistently check the patients' identity with the paperwork in the notes	There should be a designated time for all handover and cross checking, a daily safety briefing at the beginning of the shift (highlighting patients with same name). The consultant should request that trainees attend the mid-shift huddle to assess workload
13. The S4N system does not communicate with other hospital systems. In addition, the 72-hour standard is not applicable for preterm babies. The failsafe team manually codes these babies as 'too early to screen' as opposed to 'failed to meet standard'	We recommend that the NIPE S4N design is integrated within the current well-established systems within maternity and neonatal teams. The system design should be able to differentiate when babies are born preterm to decrease reliance on human processes

TABLE 2 The analysis yielded 13 recommendations.

healthcare complexity and provide meaningful recommendations for improvement in system design. The input from patients and frontline staff can further augment service planning and redesign.

References

1. **GOV.UK.** Guidance: newborn and infant physical examination (NIPE) screening programme handbook. 2021 online at: www.gov.uk/government/publications/newborn-and-infant-physical-examination-programme-handbook/newborn-and-infant-physical-examination-screening-programme-handbook
2. **Ward J, Clarkson P, Buckle P, et al.** Prospective hazard analysis: tailoring prospective methods to a healthcare context. Patient Safety Research Portfolio. 2010 online at www.repository.cam.ac.uk/handle/1810/335652.
3. **CARe.** CARe QI: A handbook for improving quality through resilient systems. 2020 online at: https://resiliencecentre.org.uk/care-qi-handbook
4. **Hignett S, Jones E, Miller D, et al.** Human factors and ergonomics and quality improvement science: integrating approaches for safety in healthcare. BMJ Qual Saf 2015;24:250-54.
5. **Carayon P, Wooldridge A, Hoonakker P, et al.** SEIPS 3.0: Human-centered design of the patient journey for patient safety. Appl Ergon 2020;84:103033.
6. **Carayon P, Schoofs Hundt A, Karsh B, et al.** Work system design for patient safety: the SEIPS model. Qual Saf Health care 2006;15:50-58.
7. **Holden R, Carayon P, Gurses A, et al.** SEIPS 2.0: a human factors framework for studying and improving the work of healthcare professionals and patients. Ergonomics 2013;56:1669-86.
8. **Canham A.** Examining the application of STAMP in the analysis of patient safety incidents. Loughborough Research Repository 2019:1-288.
9. **NHSE.** Brief guide to conducting observations. 2022 online at: www.england.nhs.uk/wp-content/uploads/2022/08/B1465-Observations-v1-FINAL.pdf
10. **Jimmerson C, Weber D, Sobek DK.** Reducing waste and errors: piloting lean principles at Intermountain Healthcare. Jt Comm J Qual Patient Saf 2005;31:249-57.
11. **Laursen ML, Gertsen F, Johansen J.** Applying lean thinking in hospitals – exploring implementation difficulties. 3rd International Conference on the Management of Healthcare and Medical Technology. 2003 online at: www.hctm.net/publications/publications.html
12. **Mazzocato P, Savage C, Brommels M, et al.** Lean thinking in healthcare: a realist review of the literature. Qual Saf Health Care 2010;19:376-82.
13. **Kanki B, Null C.** Cognitive functions and human error. Space safety and Human Performance 2018:1-16.
14. **Young M, Brookhuis K, Wickens C, Hancock P.** State of science: mental workload in ergonomics. Ergonomics 2014;58:1-17.
15. **NHSE.** Safety action development guide. 2022 online at: www.england.nhs.uk/wp-content/uploads/2022/08/B1465-Safety-action-development-v1.1.pdf
16. **NHSE.** Plan, do, study, act (PDSA) cycles and the model for improvement. Online at: www.england.nhs.uk/wp-content/uploads/2022/01/qsir-pdsa-cycles-model-for-improvement.pdf
17. **Chhokar R, Engst C, Miller A, et al.** The three-year economic benefits of a ceiling lift intervention aimed to reduce healthcare worker injuries. Appl Erg 2005;36:223-29.
18. **NHS Institute for innovation and Improvement.** A guide to creating and interpreting run and control charts. 2009 online at: www.england.nhs.uk/improvement-hub/wp-content/uploads/sites/44/2017/11/A-guide-to-creating-and-interpreting-run-and-control-charts.pdf
19. **Braithwaite J.** Changing how we think about healthcare improvement. BMJ 2018;361:1-5.
20. **Chartered Management Institute.** Implementing an effective change programme. 2014 online at: www.managers.org.uk/wp-content/uploads/2020/03/CHK-040-Implementing_an_effective_change_programme.pdf
21. **Leary R.** The guide to handling people. Fourth ed. National Back Pain Association:2004. ISBN:0953058298.