Abstract

Introduction: Newborn feeding is key to infant growth and survival. Accurate feeding documentation can inform care decisions and planning of care. A nutritional dashboard is available within the Electronic Health Record (EHR) which accumulates feeding data in a graphical display.

Purpose: To improve the quality of newborn feeding documentation for post-natal ward babies and babies in the Neonatal Intensive Care Unit (NICU).

Design and Methods: A multidisciplinary end user expert group (n=38) was established. Qualitative thematic analyses from this group were used to design new feeding data entry and review elements. Quantitative pre-post design was used to assess feeding documentation for both post-natal ward baby charts (n=134) and NICU baby charts (n=188). Descriptive statistics and Pearson's chi-square were used to assess pre-post differences and statistical significance. The use of a nutritional dashboard was assessed using system audit logs and analyzed using Poisson regression testing.

Results: Post-natal ward babies had improvements in structured feeding documentation by 91.6% (from 17.9% to 34.3%) (p= 0.031). NICU data feeding documentation improved by 25% (from 72.3% to 90.4%) (p=0.001). Use of the nutritional dashboard however reduced in the post period.

Conclusion: This study has positively demonstrated improvements in the quality of newborn feeding documentation within the patient's EHR can be achieved through a collaborative multidisciplinary approach optimising EHR design.

Practice Implications: The benefit of a multidisciplinary approach to EHR design is paramount to promoting superior quality data entry compliant with individual workflows.

Keywords: Newborn feeding, EHR, Electronic health record, data quality, NICU feeding, optimization.

Infant nutrition has a key role to play in growth and development, and can have a profound impact on society in terms of reducing obesity and chronic disease prevention (Food Safety Authority of Ireland., 2012). The first year of life is a period of rapid growth and development (Food Safety Authority of Ireland., 2012). Infants born prematurely face numerous challenges including being vulnerable to suboptimal nutrition (Brennan et al., 2018). Premature infants are born at a critical time of brain development which can involve some complex and precisely programmed neurodevelopmental events (Aarnoudse-Moens et al., 2009; Sammallahti et al., 2017). This in turn poses a risk to the preterm brain being vulnerable to numerous insults and consequently leading to a high incidence of lifelong neurodevelopmental, cognitive, behavioral, and motor impairments (Aarnoudse-Moens et al., 2009; Sammallahti et al., 2017). Nutrition support can play an important role in the neurodevelopment of the preterm infant (Nava et al., 2024). Early nutrition is one of the interventions that can act to modify the development of the preterm brain and perhaps mitigate any long term neurodevelopmental outcomes (Nava et al., 2024). As the postnatal nutritional support may not optimally match the third trimester intrauterine growth, this can lead to high rates of faltering growth for preterm infants (Franz et al., 2009) and it is for this reason that postnatal nutritional support should be optimized (Franz et al., 2009; Keunen et al., 2015; Ottolini, et al., 2020; Schneider & Garcia-Rodenas, 2017). To assist clinicians in making decisions around nutritional optimisation; having accurate and timely information can assist in care planning and nutritional progression (Cardin, Conner, et al., 2023). Within an Electronic Health Record (EHR), the use of data to extract information and develop into knowledge to support clinical decision making, is described as a critical success factor for an organization (Oliveira et al., 2005). Some elements of clinical data are routinely used to guide clinical care such as measurable attributes of blood pressure, heart rate and temperature. Nutrition and growth also need to be closely monitored to overcome any nutritional deficits

during this critical growth phase particularly transitioning from parenteral nutritional to enteral nutrition (Brennan et al., 2018). Real life challenges have been identified around data quality in clinical organizations attempting to extract data in relation to newborn feeding (García-de-León-Chocano et al., 2015) and highlight the need for the EHR to show an accurate view of the real clinical situation of patients (García-de-León-Chocano et al., 2015; Liaw et al., 2013). Systematic errors associated with the information systems structure can hinder accurate data quality (Weng et al., 2012). The dimensions of data quality vary and include accuracy and reliability, timeliness, coherence, accessibility, and relevance (Health Information and Quality Authority, 2018). The quality of data input can strongly influence the quality of the results (Oliveira et al., 2005; Sattler & Box, 2001) and interpretation of data into knowledge. Since the beginning of modern nursing, nursing data have been the most potent source of data for planning and improving the quality of care (Atak et al., 2023). The importance of documenting newborn feeds can contribute to the plan of care and promotes consistency and safety of the infant (Cardin, Conner, et al., 2023). The benefits of careful documentation regarding the quality of the feed can communicate the infant's progress to the wider interdisciplinary team and has been identified as a crucial aspect of care (Cardin, Conner, et al., 2023).

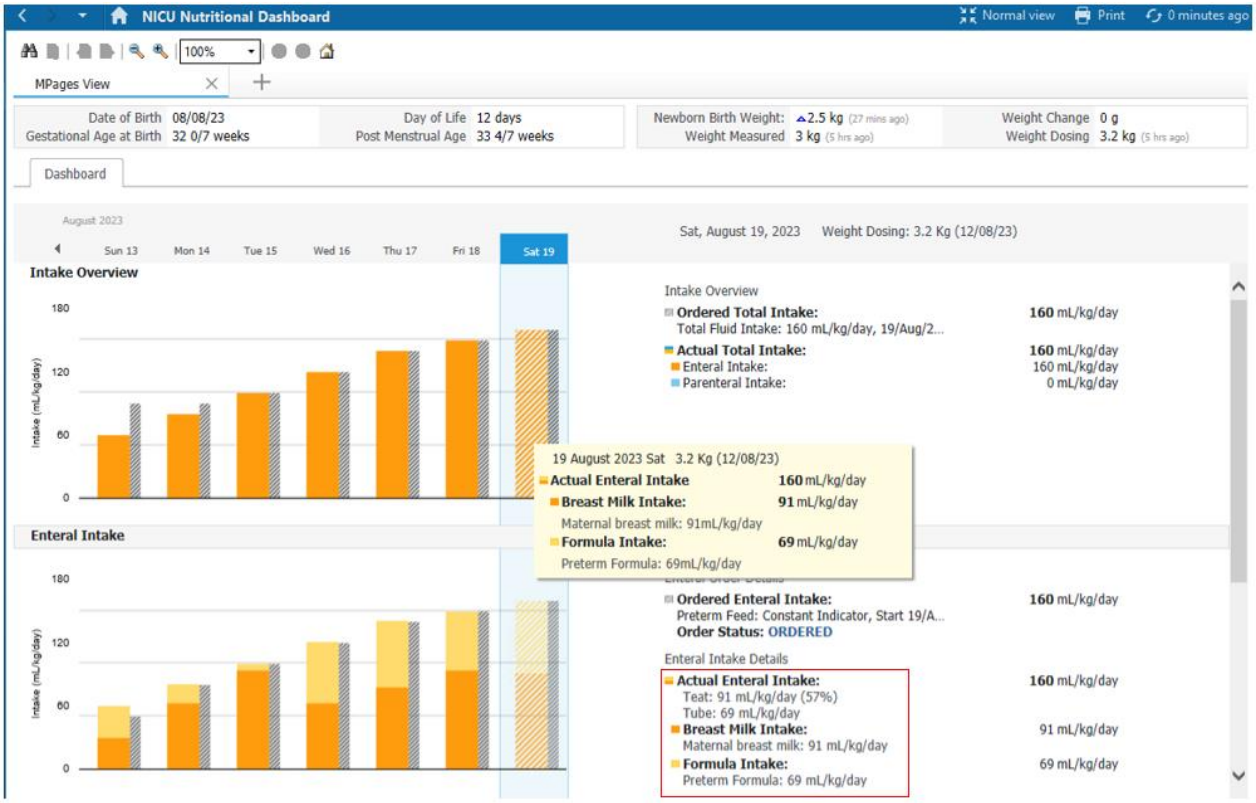
Background

The Maternal and Newborn - Clinical Management System (MN-CMS) is a national project implementing a single national EHR for maternity and neonatal services in Ireland (eHealth Ireland, 2018). With a national birth rate of 57,540 in 2022 (Central Stastistics Office, 2023), MN-CMS currently supports 40% of the births in Ireland, in 4 maternity hospitals/units, with a plan to implement to all 19 maternity units in the country (eHealth Ireland, 2018). The MN-CMS newborn EHR contains various data points on newborn feeding for both well babies on post-natal wards and babies admitted to the Neonatal

Intensive Care Unit (NICU), completed by the midwife and NICU nurse. The MN-CMS project was instrumental during the EHR design in developing a nutritional dashboard for infants which provides a graphical display of daily intakes consisting of nutritious and non-nutritious parenteral fluids and enteral feeds. The enteral graph of the nutritional dashboard is populated by the feeding data entries in the EHR (See Figure 1). The nutritional dashboard displays enteral feeds based on feed type (breastmilk or formula) and by method the milk was received (teat or tube). This graphical display of feeding progress has the potential to enhance feeding and nutrition review for the entire multidisciplinary team and contribute to the knowledge to support clinical decisions, however due to data quality issues based on feeding input, the graphical display is sometimes unreliable. The well post-natal ward infants also have inconsistent feeding documented in their EHR as a dual paper process is maintained. This causes difficulties in reviewing feeding progress particularly if care is transitioned when transferred from post-natal ward to the NICU due to numerous duplicated data fields. This mixed methods research study aimed to review the current workflows to change the systematic format of feeding data entry within the EHR for post-natal ward and NICU babies, to enhance compliance with the data completeness and correctness. A consistent data entry format was developed for all users to input all infant feeds. All changes to the national MN-CMS system were carried out in accordance with the strict change control pathways in place.

Figure 1:

NICU Nutritional Dashboard view display enteral intake with breakdown of Feed type and feeding method.



Purpose

This study proposed to 1) improve the data quality in relation to newborn feeding for well healthy newborns on post-natal wards and those admitted to the NICU and 2) improve the utilization of the NICU Nutritional Dashboard.

Design and Methods

Ethical approval was granted for the inclusion of all four hospitals in this study who utilize the EHR and from the project's information governance group. Separate ethical approval was granted for Site A and B (ECM 4 (c)), Site C (REC-2022-007) and Site D (EC17.2022). Three hospitals were tertiary referral sites with Level III NICUs (Neonatal Intensive Care

Units), and one site was a local maternity unit. Qualitative and quantitative assessment evaluations before and after the development and implementation of the changes in EHR data were used to evaluate the revised data entry format for all users to input all infant feeds.

(i) Qualitative

For the qualitative assessment, a purposive sample of subject matter experts were included and therefore established the multidisciplinary expert group, with representation from all relevant disciplines who use the EHR daily and members of the national project team. Forty-one participants were invited to take part. In total 38 participants engaged in the group and signed a voluntary consent to participate in the study. The sample representation (n=38) is displayed by discipline in Table 1. There was a larger number of nurses and midwives than there were medical, dietetic, lactation consultants for example but this mirrors the staff mix in the clinical care. The expert group was coordinated by the first author who is the NICU workstream lead for the MN-CMS project and has an in-depth knowledge of the EHR.

Table 1:

Expert group participants represented by discipline.

NICU Nurses	5
Midwives	13
Neonatology Consultants	2
Neonatal Non-Consultant Hospital Doctors (NCHD) and Advanced Nurse Practitioners (ANP)	2
Dietitians	3
Lactation Consultants	6

National Project Team	7
Total	**38**

This expert group was used to identify the current issues and "sticky points" around poor data entry for all infants both on post-natal wards and NICU. They were instrumental in deciding the EHR changes to improve the data capture. Due to COVID19 restrictions in healthcare facilities, the group met via teleconference on five occasions lasting for one hour each. Sessions were recorded and a transcript generated from the teleconference application. These transcripts were verified by the lead author, who was the coordinator of the group sessions. The first session, which had a wide representation of all disciplines across all 4 sites, was used to understand the current workflows and issues identified from various perspectives. The subsequent sessions had various members at different times who contributed to the final design of the EHR feeding entry and review changes. Not all members were present for all sessions but there was always good multidisciplinary representation. The questions explored with the group for the initial meeting were as follows:

1. What works well for infant feeding input and reviewing?
2. What does not work well for infant feeding input and review?
3. What would make data entry easier?
4. Do you use the NICU Nutritional Dashboard?

a. If so, what do you like about it?

b. If not, why do you not use it as a review tool?

5. What would help with the review of infant feeding?

(ii) Quantitative

The data quality and completeness were quantitatively assessed by reviewing newborn EHR data for inpatient newborns in the four hospitals included in this study. Data were collected for a 24-48-hour period looking at the feeding entry of newborn inpatients, receiving nutritive milk feeds (>40mls/kg/day), on a selected date to obtain pre and post measurements. The sample size was calculated to detect a 20% improvement in data entry for both NICU babies (n=188) and the post-natal ward babies (n=134). The sampling method was convenience sampling of newborn inpatients in the NICU or post-natal ward. There was a separate pre and post sample cohort for both groups, the NICU group had 94 pre and 94 post and the post-natal ward group had 67 pre and 67 post. The post data was collected approximately two months after the changes were implemented. Key data entry for accurate population of the nutritional dashboard were identified using the dimensions of quality based on the Health Information and Quality Authority (HIQA) framework (Health Information and Quality Authority, 2018) as the primary measure of completeness. The dimensions of data quality are accuracy and reliability, timeliness, coherence, accessibility, and relevance (Health Information and Quality Authority, 2018). When each of these dimensions were met- the data quality was considered complete and accurate to populate the nutritional dashboard. These are displayed in Table 2 with an example of the EHR data entry to achieve the dimensions of data quality.

Table 2:

Dimensions of Data Quality and EHR entry examples

Dimensions of Data Quality	EHR Data Entry
Accuracy and reliability	Appropriate feed data entered e.g., feed type, feed method, feed volume etc.,
Timeliness	Correct time column entry
Coherence	Clearly entered using discrete data entry
Accessibility	Completed in the correct feeding section
Relevance	Entry completed per feed

Additional data points were also captured and compared in the pre and post phase. Data were analyzed using SPSS 28 using descriptive statistics of cross tabulation and Pearson's chi-square test assessed the pre-post difference and statistical significance. Significance was set at 5% (0.05) meaning that a p valve of <0.05 was significant. The use of the nutritional dashboard was evaluated by extracting data log files from the EHR database to evaluate the number of times a user launched the nutritional dashboard page to open the graphical display. The statistical software program, Stata, was used to assess the launches per day and the cumulative launches over the 7-day period. Poisson regression tests were used to assess the pre-post change.

Results

(i) Qualitative

The qualitative data analysis was based on the Braun and Clarke (2006) 6-step process of familiarization of the data, generating initial codes (descriptive codes), searching for themes, reviewing themes, defining and naming themes and finally producing the report (Braun &

Clarke, 2006). Using this thematic analysis, the researchers identified three overarching themes of 1) Complex data entry 2) difficulty in reviewing the data and 3) an unreliable nutritional dashboard. The outputs from the expert group consultations varied by each of the disciplines based on their different work practices and their need to either enter or review the information.

Complex Data Entry

NICU Nurses and post-natal ward midwives, in particular spoke about how complex the feeding documentation was and how it was time consuming. They commented on how there were often too many options for various feeds, and they often don't separate different feed types on data entry as this is too cumbersome. The NICU nursing group felt the data entry was too complex (particularly with multiple feed types) with too many options and difficultly in seeing the total volumes per kilogram per day (mls/kg/day). NICU nurses also referenced multiple data entry points duplicated when newborns were moved from post-natal ward care to NICU care.

"When a baby is moved from the wards to the neo there is a feeding method newborn and feeding method NICU to complete but I'm only feeding the baby once!"

NICU Nurse, Site A

Nurses felt the data entry was complex and frustrating to enter correctly in separate time columns as designed. Nurses also commented that for some documentation- they had no structured data entry space to add this information such as "a reason formula was given".

Midwifery staff on the post-natal wards either did not enter structured data in the EHR or maintained a dual system of paper feeding charts which were either scanned into the EHR or transcribed in. They mentioned that it was too time consuming to do and they would enter data often at the end of a shift

"We get the mums to write down the feeds for the day and then we put them in the chart (EHR) at the end of the shift".

Post-natal ward Midwife, Site D

Difficulty in reviewing the data

Dietitians, Lactation Consultants and Medical staff in particular found reviewing information was difficult. Complex feeds with additives were difficult to review and users often clicked through 24-48 hours of feeding data rather than seeing an overall summary picture.

"The review of feeding is problematic to look at it at a glance and see 24-48hrs – you need to click through iView just to get an idea of what's happened."

Neonatologist, Site D

The dietitians also noted difficulty finding the first feed and that there was a lack of information around the first breastmilk or buccal breastmilk administration. Neonatologists, NCHDs (Non-Consultant Hospital Doctors) and ANPs cited difficulty in reviewing the information and inability briefly to see the "key firsts" e.g., first feed, first breastmilk. Lactation consultants voiced concerns around key national reports and the difficulty in gathering information for these reports due to the poor data completeness of newborn feeding and often newborn charts didn't even have scanned feeding charts.

"Sometimes you'd find a feeding chart scanned in (to the EHR) and sometimes not."

Lactation Consultant, Site A

An Unreliable Nutritional Dashboard

Dietitians and medical staff cited rarely reviewing the Nutritional Dashboard due to perceived inaccuracies of the display. They did acknowledge the Nutritional Dashboard had potential

for reviewing the intake and tracking feeding progress, however due to inaccuracies it was unreliable, and they lacked trust in it.

> *"The dashboard really has great potential to review the intake and track the progress but again there's too many entry options for all the different feeds and combined feed are problematic and this makes the dashboard too inaccurate to rely on…."*
>
> *Dietitian, Site C*

Dietitians noted that the complex and combined feeds were difficult to order and to review, the complex feed entry was often inaccurate leading to inaccuracies in the nutritional dashboard which could have immense potential if accurate. The medical group found that the nutritional dashboard was "just not right or correct" for use on ward rounds or presenting patients as the data entry was probably not correct in the first place.

Following the group review and in efforts to redesign the current feeding entry, work began as outlined below and followed a similar format as described by Sutton et al., (2020). The EHR provided two views – one for midwives for the post-natal ward baby and one for the NICU staff and the sick neonatal baby with often duplicated data entry points.

1. A side-by-side analysis was made of both views and a comparison was made to determine which data elements were consistent and which were duplicated.
2. Common and essential data points were identified, aligned, and eliminated if deemed not essential to capture.
3. Responses to the duplicates were aligned to provide consistency.
4. More conditional logic was built into responses i.e., based on the selection of responses, additional relevant responses would open. These would remain hidden if not selected.

5. New data capture was agreed for inclusion e.g., reason for formula feeding, type of breastmilk and administering buccal breastmilk and an ability to record the mls/kg/day per feed.
6. Commonality of the design was decided and agreed by the stakeholders.
7. A new flowsheet was built for the purpose of reviewing all the feeding data in one place.
8. The agreed design was built in the pre-production (test) environment and demonstrated to the group.

Following a detailed demonstration to the group, some minor design adjustments were made, and the group identified some key encouragement points in promoting this to the end users. An implementation plan was developed with the group for each of their sites. The strategies identified for implementation were training, identifying champions and communication via newsletters and memos. Two short information training videos were developed for the data entry for midwives (5.5minutes) and for the NICU nurses (6.5minutes) and distributed to nominees on each site to disseminate along with a quick reference guide. Each group member was identified as champions for this change and provided support and encouragement to end users. The final design was built into the live environment at an agreed time once training was complete and memos were distributed to the users.

Once the design was complete and agreed, the expert group were asked what could encourage adoption of the new changes. The group mentioned that users had been asking for changes and these should represent their requests for change and make it easier to enter feeds and capture all the required information. A member of the national project team highlighted that every patient has a right to accurate data being recorded in their EHR.

"Every patient has a right to data accuracy….and they should have correct information around care being recorded."

Member of the National Project Team of MN-CMS

A doctor noted that we need to stress the why we are doing this:

"…. the *key is almost to start with the why, why are we making this change at all? It's to try and make it better and, and bring our care more centered around one of the key things that as all health care providers ….[that] we do for babies, which is to nourish them and to do it in a way that doesn't matter where the baby is….the mother and baby and wherever they are in their feeding journey and in their care journey in the hospital"*

Neonatologist, Site A

(ii) Quantitative

Post-natal ward newborns. For the postnatal ward newborns, the overall completed structured data entry across the 4 sites increased from 17.9% to 34.3% showing a statistically significant increase of 91.6% (p=0.031). The cumulative results for the post-natal ward data entry are displayed in table 3. There was also a notable increase in key structured data points of feed type and oral volume with increases of 80.4% and 123.8% respectively. Although the aim of this study was to improve the structured data entry, some post-natal ward staff documented newborn feeding in an unstructured way by free text notes or handwritten feeding charts scanned into the EHR. As these captured newborn feeding, they were accounted for in the data collection as *other* documented feeding records for newborns. Overall, across four sites, the other feeding documentation increased by 63.4% to 68.7% of the sample having some feeding documented in their EHR. The new data changes included the reason for formula feeding and this was completed in 85% of applicable cases for post-natal ward newborns having previously not been captured.

Table 3: Cumulative data completeness results of the four hospitals and the individual data points collected for the post-natal wards.

	Pre (%)	Post (%)	Change (%)	P Valve
Feed Type	19.4	35	+80.4	0.047
Oral Volume	16.4	36.7	+123.8	0.014
Feeding Method	29.9	43.3	+44.8	0.106
Formula Type	16.4	53.8	+228	<0.001
Feed Tolerance	47.8	80.6	+68.6	<0.001
Structured Data Complete	17.9	34.3	+91.6	0.031
Other Documentation	41.8	68.7	+63.4	0.002

The structured data completeness for each site is displayed in table 4. Only one individual site (D) showed a significant improvement which was not, however, demonstrated across all four sites.

Table 4:

Individual site data quality compliance for completed structured data entry for newborn feeding on post-natal wards.

Site	Pre (%)	Post (%)	Change (%)	P Value
A	0	5	N/A	0.311
B	40	60	+50	0.371
C	10.5	15.8	+50.5	0.631
D	31.6	68.4	+116.5	0.023

NICU Newborns. The NICU chart review across the 4 hospital sites showed a data completeness to populate the nutritional dashboard significantly increase of 25%% from 72.3% to 90.4% (p= 0.001). The NICU data points collected following the chart review are displayed in table 5 and display the cumulative results of data completion across all 4 hospital sites.

Table 5:

Cumulative data completeness results of the four hospitals and the individual data points collected for NICU.

	Pre (%)	**Post (%)**	**Change (%)**	**P Valve**
Feed Type	75.5	90.4	+19.7	0.007
Oral Volume	93.8	100	+6.6	0.048
Tube Volume	91	100	+9.9	0.016
Feeding Method	64.9	86.2	+32.8	<0.001
Formula Type	74.5	94.1	+26.3	0.006
Additives	83.3	89.7	+7.6	0.415
Feed Tolerance	48.9	73.4	+50	<0.001
Feed Order	42.6	26.6	-37.5	0.021
Fluid Order	63.8	52.1	-18.3	0.104
ND* Complete	72.3	90.4	+25	0.001

*Note: **ND refers to the Nutritional Dashboard and all data inputted into the EHR accurately populated the dashboard*

The individual sites are displayed in table 6. Three sites (A, C and D) showed an increase in completeness and one site (B) remained static.

Table 6:

Individual site data quality compliance to populate the nutritional dashboard.

Site	Pre (%)	Post (%)	Change (%)	P Value
A	70	93.3	+33.2	<0.02
B	75	75	0	1.00
C	76.7	90	+17.3	0.166
D	70	90	+28.6	0.053

The *Feed Type* data entry point is especially important to capture as it allows the categorization of feed types such as breastmilk, term formula, preterm formula etc. in the reviewing process of nutritional intake. Overall, across the four NICUs this data point improved, increasing by 19.7% with statistical significance (p=0.007). The individual sites are displayed in table 7. Site A showed an increase in this feed type data point from 70% to 93.3% in the post phase, an increase of 33% completeness (p=<0.02). This data point was noted as being problematic in cases of complex feeds or with more than one feed type being administered such as combinations of breastmilk and formula.

Table 7:

Individual sites to populate the Feed Type hierarchy accurately.

Site	Pre (%)	Post (%)	Change (%)	P Value
A	70	93.3	+33.3	<0.02
B	75	75	0	1.00
C	83.3	90	+8	0.448
D	73.3	90	+22.8	0.095

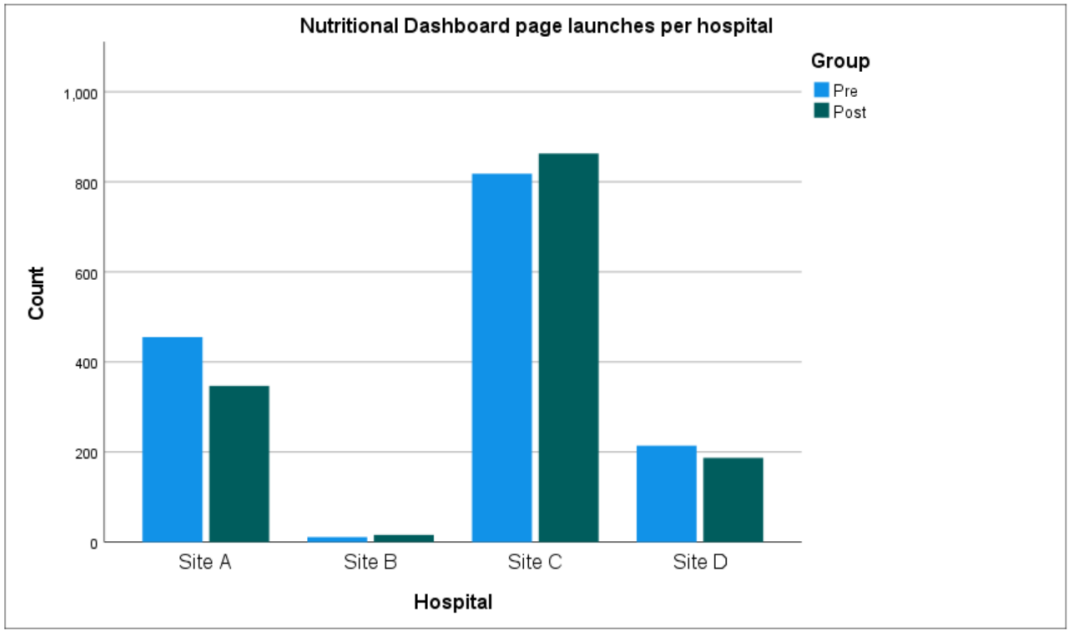
The *feeding method* (e.g., via bottle teat or tube) data entry was often duplicated in the pre phase however accuracy and completeness increased by 32.8% over 4 sites (p= <0.001) with the new design. New data entry captured in the post phase such as, the reason for formula feeding, was recorded accurately across all 4 sites in 66% of relevant cases having not been recorded previously in a structured event set. The type of breastmilk (fresh or refrigerated or previously frozen) can now be captured for newborn feeding and was done so in 56% of relevant cases.

Nutritional Dashboard

There was a 5.7% reduction in launches of the nutritional dashboard overall across the four hospitals in the post period which was not statistically significant (p= 0.115) and may account for some usual variation. Reviewing each hospital separately, hospital A had a significant reduction in launching the page with a 23.7% reduction (p=<0.001). Hospital B, albeit with small numbers had a 45% increase in usage (p=0.339), hospital C had a 5.5% increase (p=0.272), and hospital D had a 12.6% reduction (p= 0.178). This is displayed in Figure 2 below.

Figure 2:

NICU Nutritional Dashboard page launches by hospital site showing both pre and post.



Note: Site B is a smaller unit and has the lowest number of births per year however Sites A, B and C are comparable tertiary sites

The launching of the page by position showed an increase by NICU Nurses of 8.2% (p=0.119) and dietitians by 15.2% (p= 0.247) and significant reduction by medical staff by 24% (p=<0.001). Other positions are represented in table 8 and graphically displayed in figure 3.

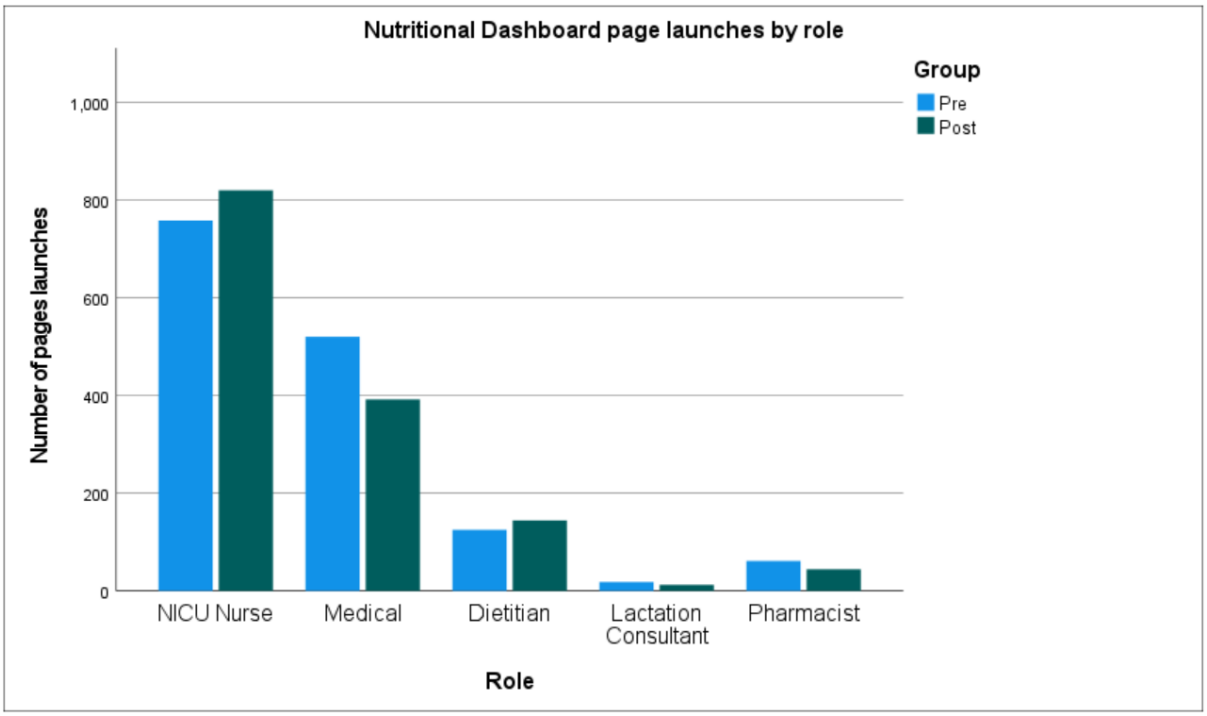
Table 8:

The use of the nutritional dashboard by user positions displaying pre and post launches, % difference, Confidence Intervals (CI), and p value.

Position	Pre	Post	% Change	95% CI		P Value
NICU Nurse	758	820	+8.2	0.98	1.19	0.119
Medical	520	392	-24	0.66	0.86	<0.001
Dietitian	125	144	+15.2	0.91	1.46	0.247
Lactation Consultant	18	12	-33.3	0.32	1.38	0.277
Pharmacist	61	44	-27.9	0.49	1.06	0.099

Figure 3:

NICU Nutritional Dashboard page launches by user roles across all four hospital sites



Discussion

This study aimed to improve newborn feeding documentation within an EHR and began by exploring the redesign of newborn feeding data entry using a multidisciplinary approach. Our study identified that users found the newborn feeding data entry complex and time consuming to complete, with some duplication and having too many options to complete. Likewise, the review of information was problematic due to the complex data entry and gathering national reports was difficult as the information often could not be found or was not entered in a structured format. We used the key contributions of the multidisciplinary team to redesign the newborn feeding; to reduce the complexity and duplication for users and ultimately improve the data quality of the newborn feeding. The improvement of data quality was observed across the NICU and the post-natal wards. The second aim was to improve the use of the nutritional dashboard by all users and although the use did not show a general improvement, NICU nurses' use of the dashboard did show an improvement. This functionality may need more education and champions to promote its use. The continuing improvement of data completeness of the feeding data entry will ensure more accuracy of the dashboard and may improve users overall trust of the dashboard for clinical use. Changes to documentation within an EHR have implications for accuracy, efficiency, user satisfaction, and workflow (Wilbanks et al., 2018) which were positively demonstrated in this study. The key data points of feed type and feed method improved in accuracy due to alignment and reduced duplication of the data entry. Accurate data entry through thoughtful and detailed documentation can provide information that promotes continuity of care for newborn feeding (Cardin, Conner, et al., 2023). Some studies identify poor data quality in feeding documentation as a limitation of their study (Cardin, Willis, et al., 2023; Healy et al., 2023). This study has streamlined feeding data entry, reduced duplication, and improved data completeness which will be beneficial for clinical review, quality improvement, audit and

research. The potential of using structured data from EHRs is the core of improvements in healthcare (Goldacre & Morley, 2022) and nurses are seen as an integral part of the team in improving data quality and data obtained by nurses in EHRs have become the most crucial source in planning care (Atak et al., 2023). With the correct and proper analysis, as undertaken in this study, improvements can be realized in quality, safety, and cost-effectiveness of care across the entire health service (Goldacre & Morley, 2022).

Limitations

Limitations of this study included a convenient sample from the four hospitals using the national newborn EHR. This project was interrupted by a criminal cyber-attack on the Irish health service data infrastructure and delayed the overall implementation of the changes from the initial multidisciplinary group meeting.

Implications for Practice

This study has contributed positively to improving data completeness around newborn feeding. The benefit of a multidisciplinary approach to EHR design is paramount to promoting superior quality data entry compliant with individual workflows. Further education, training, and awareness of the benefits of the nutritional dashboard is needed.

Implications for Research

The establishment of an expert multidisciplinary group is essential in the design of the EHR as each member has a unique viewpoint based on their individual workflows and uses of the EHR, be it data entry or data review. Qualitative research makes an important contribution for EHR design and optimisation.

Implications for Policy

Although the Irish Medical Council (IMC) gives some guidance to medical staff on recording accurate, timely, and up-to-date medical records in either paper or electronic form, the Nursing and Midwifery Board of Ireland (NMBI) give guidance only pertaining to paper records. The NMBI, who provide professional guidance to nurses and midwives, advise regular documentation of narrative notes to document patient care and progress (NMBI, 2015). These guidelines are relevant to paper records but do not support nurses recording clinical structured data in EHRs. A key recommendation from this study is that the nursing and midwifery professions need professional guidance for recording clinical care in a structured electronic format as health services embark on digital transformation.

Conclusion

Data completeness significantly improved across all four hospitals for newborn feeding in a national newborn EHR. Accurate recording of feeding can communicate the newborn's progress across the multidisciplinary team. This study has positively demonstrated that a collaborative multidisciplinary approach can improve EHR design and data quality through more accurate and complete data in the patient's EHR.

Aarnoudse-Moens, C. S. H., Weisglas-Kuperus, N., Van Goudoever, J. B., & Oosterlaan, J. (2009). Meta-analysis of neurobehavioral outcomes in very preterm and/or very low birth weight children. *Pediatrics*, *124*(2), 717–728. https://doi.org/10.1542/peds.2008-2816

Atak, G., Dogan, P., Bayer, S., Eyuboglu, Ö., Kurt, A., & Yazici, E. (2023). Electronic Health Records From The Perspective Of Nurses. *Journal of Health Systems and Policies*, *2022*, 1–9. https://doi.org/10.52675/jhesp.1233242

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Brennan, A. M., Fenton, S., Murphy, B. P., & Kiely, M. E. (2018). Transition Phase Nutrition Recommendations: A Missing Link in the Nutrition Management of Preterm Infants. *Journal of Parenteral and Enteral Nutrition*, *42*(2), 343–351. https://doi.org/10.1177/0148607116686289

Cardin, A. D., Conner, P. A., Hedrick, H. R., Hoelscher, K. D., & Petry, A. D. (2023). Understanding feeding complexity and culture in the NICU: A qualitative study. *Journal of Neonatal Nursing*, *March*. https://doi.org/10.1016/j.jnn.2023.04.002

Cardin, A. D., Willis, J. K., Althoff, R. E., Ambra, T. M., Bentley, B. A., & Marshall, S. A. (2023). Factors influencing infant length of stay and time to full oral feeding in the neonatal intensive care unit. *Journal of Neonatal Nursing*, *April*. https://doi.org/10.1016/j.jnn.2023.04.003

Central Stastistics Office. (2023). *Vital Statistics Yearly Summary 2022*. CSO Statistical Publication, 26 May 2023, 11am. https://www.cso.ie/en/releasesandpublications/ep/p-vsys/vitalstatisticsyearlysummary2022/

eHealth Ireland. (2018). *Maternal and Newborn Clinical Management System*. EHealth Ireland Website. https://www.ehealthireland.ie/Strategic-Programmes/MNCMS/

Food Safety Authority of Ireland. (2012). *Best practice for infant feeding in Ireland : from pre-conception through the first year of an infant's life.* (I. Saul & M. Flynn (eds.); 2nd ed.). Food Safety Authority of Ireland, Dublin:Ireland. https://www.fsai.ie/getmedia/936a90fa-a5a7-453c-8b2f-94666c0d27d8/best-practice-for-infant-feeding-in-ireland-2012-final-revised-2013.pdf?ext=.pdf

Franz, A. R., Pohlandt, F., Bode, H., Mihatsch, W. A., Sander, S., Kron, M., & Steinmacher, J. (2009). Intrauterine, early neonatal, and postdischarge growth and neurodevelopmental outcome at 5.4 years in extremely preterm infants after intensive neonatal nutritional support. *Pediatrics*, *123*(1), 101–109. https://doi.org/10.1542/peds.2008-1352

García-de-León-Chocano, R., Sáez, C., Muñoz-Soler, V., García-de-León-González, R., & García-Gómez, J. M. (2015). Construction of quality-assured infant feeding process of care data repositories: Definition and design (Part 1). *Computers in Biology and Medicine*, *67*, 95–103. https://doi.org/10.1016/j.compbiomed.2015.09.024

Goldacre, B., & Morley, J. (2022). Better, broader, safer: Using health data for research and analysis (the Goldacre review). In *Department of Health and Social Care*. https://doi.org/10.1088/1361-6498/ac89f8

Health Information and Quality Authority. (2018). *Guidance on Data Quality Framework for*

Health and Social Care. https://www.hiqa.ie/sites/default/files/2018-10/Guidance-for-a-data-quality-framework.pdf

Healy, D. B., Campbell-Green, B., Livingstone, V., Ryan, C. A., Ross, R. P., Stanton, C., & Dempsey, E. M. (2023). Neonatal outcomes following introduction of routine probiotic supplementation to very preterm infants. *Acta Paediatrica, International Journal of Paediatrics*, *112*(10), 2093–2101. https://doi.org/10.1111/apa.16923

Keunen, K., Van Elburg, R. M., Van Bel, F., & Benders, M. J. N. L. (2015). Impact of nutrition on brain development and its neuroprotective implications following preterm birth. *Pediatric Research*, *77*(1), 148–155. https://doi.org/10.1038/pr.2014.171

Liaw, S. T., Rahimi, A., Ray, P., Taggart, J., Dennis, S., de Lusignan, S., Jalaludin, B., Yeo, A. E. T., & Talaei-Khoei, A. (2013). Towards an ontology for data quality in integrated chronic disease management: A realist review of the literature. *International Journal of Medical Informatics*, *82*(1), 10–24. https://doi.org/10.1016/j.ijmedinf.2012.10.001

Nava, C., Lupo, E., & Lista, G. (2024). Preterm nutrition and brain development. *BMJ Nutrition, Prevention and Health*, 1–8. https://doi.org/10.1136/bmjnph-2023-000749

NMBI. (2015). Recording clinical practice: guidance. *Nursing and Midwifery Board of Ireland*, 1–16. https://www.nmbi.ie/nmbi/media/NMBI/Publications/recording-clinical-practice-professional-guidance.pdf?ext=.pdf

Oliveira, P., Rodrigues, F., & Henriques, P. (2005). A formal definition of data quality problems. *Proceedings of the 2005 International Conference on Information Quality, ICIQ 2005*, *June 2014*.

Ottolini, KM., Andescavage, N, Keller, S, Limperopoulos, C. (2020). Nutrition and the developing brain: the road to optimizing early neurodevelopment: a systematic review. *Pediatric Research*, *87*(2), 194–201. https://doi.org/10.1038/s41390-019-0508-3.Nutrition

Sammallahti, S., Kajantie, E., Matinolli, H. M., Pyhälä, R., Lahti, J., Heinonen, K., Lahti, M., Pesonen, A. K., Eriksson, J. G., Hovi, P., Järvenpää, A. L., Andersson, S., & Raikkonen, K. (2017). Nutrition after preterm birth and adult neurocognitive outcomes. *PLoS ONE*, *12*(9), 1–15. https://doi.org/10.1371/journal.pone.0185632

Sattler, K., & Box, P. O. (2001). A Data Preparation Framework based on a Multidatabase Language. *International Database Engineering and Application Symposium*, 219–228. doi: 10.1109/IDEAS.2001.938088.

Schneider, N., & Garcia-Rodenas, C. L. (2017). Early nutritional interventions for brain and cognitive development in preterm infants: A review of the literature. *Nutrients*, *9*(3). https://doi.org/10.3390/nu9030187

Weng, C., Appelbaum, P., Hripcsak, G., Kronish, I., Busacca, L., Davidson, K. W., & Bigger, T. T. (2012). Using EHRs to integrate research with patient care: Promises and challenges. *Journal of the American Medical Informatics Association*, *19*(5), 684–687. https://doi.org/10.1136/amiajnl-2012-000878

Wilbanks, B. A., Berner, E. S., Alexander, G. L., Azuero, A., Patrician, P. A., & Moss, J. A. (2018). The effect of data-entry template design and anesthesia provider workload on documentation accuracy, documentation efficiency, and user-satisfaction. *International Journal of Medical Informatics*, *118*(June), 29–35.

https://doi.org/10.1016/j.ijmedinf.2018.07.006