Implementation of a regional standardised model for perinatal electronic medical records

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Research Article

Keywords: Newborn, Electronic Health Records, Breastfeeding, Implementation, Quality improvement

Posted Date: May 23rd, 2022

DOI: https://doi.org/10.21203/rs.3.rs-1664889/v1

Abstract

Background:

Electronic recording of newborn health information contributes to improving the quality of care. Nonetheless, there is limited evidence on the implementation of perinatal electronic medical records models. We describe the development and implementation of an electronic recording model that includes data on the health care provided to both the mother and the newborn, standardised for six hospitals of a regional health care system.

Methods:

The implementation process was developed in 2 stages. During stage 1, the tool was introduced in hospitals to stablish first contact with the healthcare staff. The second stage consisted in designing a new strategy to stabilise the model. Technical issues were fixed, and a new version was drawn up based on multidisciplinary agreement. Indicators to monitor implementation were measured in both stages and compared using the chi-squared test.

Results:

During stage 1, nearly every newborn got its electronic medical record with an appropriate connection to the mother's data. However, certain forms that were meant to be filled in by staff were frequently neglected (completion rates: 36.7%-55.3%). In stage 2, there was a statistically significant increase in the completion rates of all these forms. As a result, a standardised discharge report was provided to every newborn at the end of stage 2.

Conclusions:

Implementation of perinatal electronic medical records that link maternal and neonatal data is complicated and experience in this area is limited. Here we describe the implementation process of a model that was reliable and standardised for an entire regional health care system.

Background

Although it is common to establish a basic minimum set of data for patients requiring admission at Neonatology Units, when newborns remains at the maternity ward with their parents, access to information about their care is often largely lost. These data are often not recorded on electronic formats and sometimes they are simply included as part of to the mother's medical record [1]. On the other hand, the data collected from the mother's medical record is often limited when it comes to certain aspects of the birth and the puerperium period that have a direct impact on breastfeeding and the subsequent development of the newborn [2]. Thus, aspects such as early "skin-to- skin" contact, the initiation of breastfeeding and its difficulties, and feeding of the baby at the hospital are not recorded or become difficult to access once the episode is ends [3].

Another aspect to keep in mind is that the complexity of newborns seen in maternity wards has risen significantly over the past few years. Many of the neonatal conditions that were previously at neonatal units are now handled at maternity wards with the aim of preserving the bond between parents and baby [4]. In addition, several procedures and screening tests are conducted on newborns in this area [5]. It would be convenient for all this information to be collected in a report that facilitates continuity of care, which is an unusual occurrence [6].

Despite the interest shown by scientific associations related to perinatology [7], there is limited evidence on the implementation of perinatal clinical records (PCR) for all births in a region, both nationally and internationally. Therefore, a significant amount of published models are based on data collected from birth certificate records or, at best, are systems that collect a basic minimum set of data including an incomplete set of indicators [8–10]. Thus, the lack of accessible data repositories has a negative impact on continuity of care for both mothers and infants [11].

Since 2017, the Murcian Health Service has been developing a project to ensure health care for the first 1,000 days of a child's life [12]. This period includes conception, pregnancy, and life period until the infant's second birthday. This stage is critical for neurodevelopment and future health as an adult [13, 14]. A key foal of this project is to implement structural enhancements that allow for continuity of care for all children from birth. One of the tools implemented to achieve this goal is a common PCR model for all its hospitals handling deliveries.

The PCR of the Murcian Health Service' includes the data collected from the mother's medical record (pregnancy information, delivery and puerperium-breastfeeding). Moreover, assessments, tests, and procedures conducted on the babies during their stay at the maternity ward are also recorded. At the time of discharge, the parents are provided with a report summarising this information, which makes continuity of care easier.

This study aims to describe the structure of the PCR, the care protocols linked to it, and the process of implementation in the Murcian Health Service's hospital network.

Methods

Context and Baseline

The Murcian Health Service is a public health system that processes approximately 13,000 new births each year. It includes six hospitals with maternity ward that handle 53%, 20%, 12%, 9%, 4% and 4% of the births in the region. Of these pregnancies, 23% of mothers are foreign, predominantly Moroccan (74% of them).

In 2018, the Regional Assembly of Murcia passed law 12/2018, an amendment of the law 3/2009 on the rights and obligations of the healthcare system users, bolstered by popular initiative. This act includes,

among other aspects, the legal right of the newborn to have healthcare identity. This new law provides legal support to ensure the independence of newborns' medical records regarding the care they receive.

Prior to this project, newborn babies in the Murcian Health Service already received a medical record number at birth. Nevertheless, data from the mother and the gestational period were collected in the mother's record and were not linked to the newborn's record. On the other hand, all information related to neonatal care of each maternity ward was managed by each hospital. Records were mostly paper-based, the information provided at discharge was insufficient, and the minimum basic data set for the region was very limited in this regard.

In 2015, the Santa Lucía General University Hospital developed a PCR model based on a previous one designed at Virgen del Castillo Hospital (both part of the Murcian Health Service). This model was monitored for two years, and its reliability and applicability to the other hospital of the Region of Murcia were verified.

Description of the Tool

Hospitals in the Region of Murcia manage the patients' medical record using the software SELENE® (CGM Global. Woodbridge, UK) [15]. Mothers' and babies' record are comprised of several forms containing indicators related to the mother's clinical care, neonatal care, and other aspects such as skin-to-skin contact and breastfeeding (Table 1).

Table 1
Perinatal clinical record forms and indicators.

Form	Information gathered	Who makes it and location
Data transfer from mother to baby	Data on the pregnancy and childbirth follow-up. Mother's medical background and demographic data.	Automatically generated based on entries in other forms.
Neonate	Transition of the newborn (Apgar score, umbilical cord pH and resuscitation). Skin to skin contact indicators	Midwife in the delivery room.
Reception	Neonatal anthropometry and procedures upon arrival to the maternity ward. Identification of risk factors.	Nurse in maternity ward upon arrival of the baby.
Daily progress	Vital signs and daily weight, excretion pattern, blood glucose, etc. Supplements to breastfeeding.	Nurses and nurse's aides in maternity ward.
First breastfeeding	Time of breastfeeding initiation and assessment of first intake.	Midwife in the delivery room or maternity ward.
Subsequent breast feedings	Assessment of breastfeeding during stay at maternity ward. Breast problems and identification of risk situations.	Midwives and nurses in maternity ward.
Discharge	Overview of baby's feeding during the stay. Recording of screenings and procedures.	Nurse in maternity ward at discharge.
Care	Relevant medical data during stay: physical exam, additional tests, diagnoses, treatments and follow-up.	Paediatrician in maternity ward at discharge.

These forms are filled in by the different professionals involved in a predetermined order, from the admission of a pregnant woman for childbirth until she is discharged with the baby. Figure 1 summarises the clinical route of neonatal care, including the order of the interventions, the staff responsible for each of them, and the date and time of recording.

After childbirth, the neonate receives its own medical record number, and its first care process is started (newborn process). The aforementioned forms are created during this process. Then, an automatic linking form is generated ("data transfer from mother to baby") and transfers all relevant clinical information in the mother's record to the newborn's record. This information is summarised in an accessible report with portable format ("perinatal data report"), which speeds up subsequent medical examinations by the paediatricians.

At the time of hospital discharge, the family receives the "neonatal care report". This report retrieves the main the main information from the reports created beforehand for the parents and to ensure continuity of care. The care report and the forms from which it collects the information are standardised and identical in all hospitals handling deliveries within the Murcian Health Service.

Implementation Stages

Stage 1: diffusion, training and monitoring (from September 2017 to December 2018). During this initial stage of 16 months, appropriate interventions were carried out in order to introduce the new tool in hospitals, ensure that the staff was familiar with it, and encourage changes in working protocols. For this purpose, during the first month, project managers conducted several training sessions at each hospital. These sessions were attended by members of management, heads of departments, maternity supervisors and other selected professionals.

Once these sessions concluded, we started to gradually implement the PCR system at each hospital; due to technical difficulties, this process lasted until November 2017. The procedure followed in each hospital consisted in: conducting the necessary training sessions to ensure all personnel shifts were covered, implementation of the programme and physical attendance of software technicians until it was in a stable state.

Over the 13 following months, hospital departments were working with the new forms and reports, and continuously submitting feedback regarding issues observed during this stage. This information was gathered by the staff in charge of implementation. Two assessments were conducted during this stage: one in April 2018 (intermediate), and one in December 2018 (final), in which completion indicators were analysed. In June 2018, in light of the results obtained from the intermediate assessment, a face-to-face meeting was held with representatives of the different professional groups involved at each hospital. In this meeting, the problems detected were discussed, along with other suggestions and needs. Based on this discussion, different areas for improvement were identified and included in the PCR. Despite these changes, the final assessment did not yield the expected results.

Stage 2, stabilisation, started in January 2019 and ended in June 2019. Due to the low adhesion of professionals to the PCR model, a different strategy was designed in January 2019 to achieve model stabilisation. In February 2019, a team comprised of a paediatrician, a midwife, a nurse and a technical support engineer of the application visited all six hospitals in order. The meetings at each hospital were attended by members of hospital management, supervisors, heads of departments and medical professionals (midwives, nurses, nursing assistants, obstetricians and paediatricians) with privileged knowledge about the development of the program locally. The implementation indicators of the hospital were thoroughly analysed in these meetings, the operational aspect of the application was verified, and many different suggestions were discussed.

Once these meetings concluded, in March 2019, technical issues were fixed, suggestions were analysed, and the team in charge of the PCR implemented the necessary changes for the new version of the PCR. Several interviews were also held with representatives of mothers' associations to inform and improve the update process. A project report was drafted including all the improvements implemented. It was then submitted to each hospital before implementing the changes. Lastly, in April 2019, the PCR's system was updated to the last version. There was a series of telephone calls to verify the proper operation of the system, solve minor issues, and asses the adhesion rates of medical professionals. In June 2019, a new evaluation was conducted to assess the impact of the changes on the indicators.

Process Evaluation

The implementation process of the PCR was evaluated in all its stages using a set of indicators aimed at evaluating its technical suitability, the compliance of medical professionals with the systems, and improvements implemented (Table 2).

Table 2
Assessment indicators

Target	Indicator (type)	Format	Target
Healthcare identity of the newborn	Newborns with own medical record number (quantitative)	Newborns with any associated form Total number of newborns	> 95%
Connection between mother's and infant's record	Newborns with "data transfer from mother to baby" form (quantitative)	Newborns with "data transfer from mother to baby" form Total number of newborns	> 95%
Optimisation of electronic PCR	Structural or route modifications (quantitative and qualitative)	Number and specification of structural or route modifications introduced.	
Safety/decision. Making aspects	Changes in safety/ decision making (quantitative and qualitative)	Number and type of changes related to safety and decision-making.	
Adherence of professionals to model	Rate of completion of neonatal form (quantitative)	Newborns with "neonate" form Total number of newborns	> 95%
Adherence of professionals to model	Rate of completion of reception and first breastfeeding forms (quantitative)	Newborns with reception / first breastfeeding form Number of newborns admitted in the maternity ward.	> 95%
Adherence of professionals to model	Completion of discharge and care forms (quantitative)	Newborns with discharge / care form. Number of newborns discharged from the maternity ward.	> 90%
Adherence of professionals to model	Provision of care report (quantitative)	Newborns with care report Number of newborns discharged from the maternity ward	> 90%

The information used to calculate the indicators was entered in a computer database. Statistical analysis was conducted using SPSS® 21.0 (SPSS Inc., Chicago, Illinois, USA). The numerical values are expressed with their absolute and relative frequency, in percentages. For cases in which variable comparison was

conducted, the test used was the chi-squared test. A bilateral random value of lower than 1% ($p < 0.01$) is considered statistically significant.

Results

During the two stages of the project, 21,283 childbirths were included for the analysis. Of them, 2,046 (9.6%) required hospitalisation at neonatology units for the first few days of life, 1,427 (6.7%) of the referred from the delivery room. Thus, 19,856 neonates were admitted in maternity wards, of which 19,237 were then discharged from the hospital.

One of the project's aims was to ensure that infants haver their medical record with an adequate link to the data collected in their mother's record. This objective was achieved and maintained from the very first months of stage 1. Creating a record number is a must for any procedures that must be conducted on the infant, and the form "data transfer from mother to baby" is generated automatically. As a consequence, the value of the indicator "healthcare identity" was 100%, during both stage 1 and 2. The values for connection between mother's and infant's medical records were 100% in stage 1 and 98.3% in stage 2.

Regarding voluntary completion forms by the staff, "neonate" and "reception" achieved the highest adherence. Their adherence rates were above the target value set in both stages and there were no significant differences between them (Table 3). The "discharge" form was close to the limit of the objective in both stages, just below the limit in the stage 1 and just above it in stage 2 (Table 3).

Table 3
Completion rate forms by staff by stages.

Form	Stage 1	Stage 2	p
Neonate	14,400 / 14,938 (96.4%)	6,110 / 6,345 (96.3%)	0.745
Reception	13,945 / 13,945 (100%)	5,856 / 5,911 (99.1%)	< 0.001
First breastfeeding	7,550 / 13,945 (40.4%)	4,312 / 6,238 (72.9%)	< 0.001
Subsequent Breastfeedings	7,463 / 13,499 (55.3%)	3,712 / 5,738 (64.5%)	< 0.001
Discharge	12,805 / 13,499 (94.9%)	5,462 / 5,738 (95.2%)	< 0.001
Newborn care	4,956 / 13,499 (36.7%)	3,723 / 5,738 (64.9%)	< 0.001

During stage 2, stabilisation, our efforts were mainly focused on the "first breastfeeding" and "care" forms. For the first one, the visits to the hospitals showed confusion regarding the person in charge of filling them in when breastfeeding had not been started in the delivery room. For the second one, paediatricians communicated the issues that caused low completion rates along with their suggestions to solve them. Once the changes were applied, the value of these indicators rose progressively beyond the target (Table 3 and Fig. 2). The completion rate of the "subsequent breastfeedings" form increased during stage 2, but remained below target at the end of the stage (Table 3 and Fig. 2).

During the implementation process of the PCR, improvements were implemented based on a total of 35 incidents detected: thirteen in June 2018 evaluation and 22 in March 2019 evaluation. Most changes (21 out of 35) were related to form design issues detected during use. Ten changes were added with the purpose of increasing patient safety. Some examples are direct uploading of laboratory data in order to avoid transcription mistakes, and the application of valid ranges and alerts to avoid incorrect recording. Finally, four alert indicators were designed (risk allergy to cow's milk protein, hypoglycaemia risk, neonatal sepsis risk, and genital mutilation risk in girls) to help with the decision-making process. These indicators, based on certain established criteria, alert professionals and allow for the activation of the relevant action protocols.

Discussion

The project presented in this document has entailed implantation of a unique model of PCR model for every childbirth in the hospitals of the Region of Murcia. This model provides hospitals not only with a piece of software, but also a clinical route for the care of healthy newborns, based on scientific evidence, which contributes to improving the health results of both mothers and infants [16, 17]. The complete digital transformation of the records makes information more accessible, adds security mechanisms to prevent mistakes, provides algorithms that alert clinicians in situations of risk, and, ultimately, contributes to improving patient safety [18–20].

From an institutional point of view, having a standardised PCR model at hand allows us to move towards a decrease in clinical variability. This model makes it easier for professionals to adapt to the clinical route and promotes a more equitable and coordinated healthcare across different health areas. Furthermore, having key indicators such as the rates of skin-to-skin contact rates or exclusive breastfeeding at discharge, with a population base, in real-time, and broken down by health area, allows for a close monitoring of clinical practices at each hospital and provides opportunities for improvement [21–23].

A key goal of the project was to achieve a report submission rate close to 100%, this goal was reached in June 2019. Strategically, care report is a key element, because it summarises the procedures conducted on newborns, guarantees that the information is transmitted to their parents, and ensures continuity of care. These aspects are vital in regions like ours, in which language barriers are common.

As a whole, the PCR model presented yields benefits not only for users, but also for healthcare professionals and institutions. Therefore, in July 2021, the Spanish Ministry of Health, Consumer Affairs and Social Welfare, as part of the call for "Good Practices within the National Health System" of 2019, classified this project as a practice in the category of reproductive health [24].

The experience of the implementation of this PCR model has taught us some important lessons to consider in future projects. A collaborative and inclusive approach with healthcare professionals, visiting each hospital, and holding the necessary multidisciplinary meetings are highly beneficial time investments. Some of the most innovative developments came up from the contributions of the professionals at these meetings. On the other hand, the reality of each hospital was often different from

what we thought it would be. Dealing with these problems swiftly and on-site contributed to solving the issues and improving the motivation of the staff. In fact, positive impact on the indicators reached its peak when the project adopted a closer approach.

Limitations

This project continues to evolve since the end of stage 2. The challenges encountered with the “subsequent breastfeedings” form motivated more in-depth update of the project and a new version, which is still under evaluation. Another line of action underway is currently analysing the quality of recorded data. Previous studies warned against potential mistakes made by PCR users when recording data [25, 26]. In stage 3 of this project, we are evaluating data consistency with reality through random telephone surveys targeted at mothers.,.

Conclusions

There is a significant area for improvement in the digitalisation and standardisation of data related to the care of healthy newborn care at maternity wards. The PCR Implemented in the Region of Murcia is an innovative example of this, with a standardised model that has been implemented throughout its entire network of hospitals.

The implementation process of this type of projects is not easy. In our experience, a collaborative approach that takes professionals involved into account is a key factor. Based on this information, the implementation of the measures described above has made it possible to reach nearly universal implementation in the target population.

Declarations

Conflict of interest statement

The authors declare no conflicts of interest in this study.

Role of funding source

This study has no funding sources to declare.

Ethical Approval

The study protocol was approved by the Ethics Committee of Healthcare Areas II and VIII of Murcian Health Service.

Informed Consent

Not applicable.

Authors' Contributions

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Leante-Castellanos. The first draft of the manuscript was written by Leante-Castellanos and Mañas-Uxó, and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Figures

Figure 1

Clinical route of neonatal care. Forms surrounded by a white circle are filled by midwifes; white hexagon: nurses; white rhombuses: paediatricians; white squares: automatic forms. [1] The first breastfeeding form may be recorded at the delivery room or at the maternity ward depending on where breastfeeding starts.

Figure 2

Evolution of rate completion by form.