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The design and implementation of an integrated electronic information system for the perfusion and extracorporeal oxygenation nursing unit at la Fe University Hospital in Valencia, Spain.

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ABSTRACT

Introduction. The integration of health information systems has transformed the management of and access to medical records. Electronic health records (EHRs) play a major role in this process. In the surgical area, electronic records improve efficiency, safety, quality of care and allow for the secondary use of data for research. These systems have to centralise data, be secure, allow for the integration of medical teams, interoperate with other systems, and provide support for decision-making, adapting to clinical and technological advances.
Goal. The goal of this study is to design and implement an integrated electronic information system for the perfusion and extracorporeal oxygenation nursing department at La Fe Hospital.
Material and Method: There were several different phases in the development of the system: conceptual design, analysis of paper systems, the review of variables and data, design of the electronic register, prototyping, the evaluation of connections and interoperability, the validation of the prototype and implementation.
Results. Printed records and variables from haemodynamic, respiratory and monitoring support devices were thoroughly reviewed. This data was digitised and a prototype EHR was created using Philips ICCA software. The system includes a pre-operative checklist, perfusion report, automated monitoring chart, and records of drug administration and surgical times. It is integrated with the hospital's EHR, improving management, optimising resources, increasing patient safety and facilitating decision making. The unification of records allows for secondary use in research.
Conclusions. The implementation of the electronic record in the perfusion and extracorporeal oxygenation nursing department has improved decision-making, resource management, patient safety and quality of care. In addition, it facilitates the evaluation of indicators and ongoing improvement, allowing for the use of unified data in research.

INTRODUCTION

The integration of health information systems is a revolution that has transformed the way medical records are managed and accessed. Electronic health records (EHRs) have become the core of this transformation. However, effective implementation requires a careful approach and close collaboration between healthcare workers, technology developers and managers (1-8).

As for electronic records in the surgical area, they play a key role in improving efficiency, safety, quality of care and the secondary use of data for research purposes (5).

Some of the characteristics that these information systems should have are: the centralisation of data in a single system, secure and authorised access, complying with all data protection regulations, allowing for the integration of medical equipment and devices, allowing for interoperability with other information systems, helping healthcare workers by means of user-friendly systems and simple navigation, and providing support for decision making. There is another fundamental aspect – personalisation and adaptability in accordance with the clinical context and any technological and clinical advances that are made (9-10).

In addition, systems should provide quick and centralised access to patient information, help reduce errors and duplication through the use of checklists, favour coordination between teams and healthcare workers, contribute to improving the planning and management of surgery, as well as allowing for postoperative patient follow-up and continuity of care with patient transfer from one department to another. Finally, they should be accessible for the secondary use of the data through clinical outcome indicators and/or for clinical research purposes (11).

The aim of this study was therefore to design and implement an integrated electronic information system for the perfusion and extracorporeal oxygenation nursing department at La Fe Hospital.

MATERIAL AND METHOD

The idea was to install an integrated electronic information system for the perfusion and extracorporeal oxygenation nursing department at La Fe Hospital. The following phases were implemented: the conceptual design of the idea, an analysis and review of currently available paper-based information systems, a review of each variable and data, design of the record in the information system, design of the prototype, evaluation and creation of connections and interoperability between systems, equipment and devices, and the validation of the prototype and implementation.

- Phase 1. Conceptual design of the idea. Goal: to define the overall vision of the system and the goals to be met.
    - Task 1.1. Initial stakeholder meeting: talk with doctors, nurses, administrators and technicians to understand their needs and expectations.
    - Task 1.2. Define goals and scope: establish what problems are to be solved and what improvements are expected.
    - Task 1.3. Identification of general requirements: compile a preliminary list of necessary functionalities and constraints to be taken into account.
    - Task 1.4. Create a vision document: draw up a document describing the overall vision of the system, including the main goals, scope and expected benefits.

- Phase 2. Analysis and review of currently available paper-based information systems. Goal: to understand the current workflow and data handled in paper-based information systems.
    - Task 2.1. Review of current documents: analyse all forms, records and paper documents used in the department.
    - Task 2.2. Staff interviews: conduct staff interviews and surveys to identify problems and critical points in the current system.
    - Task 2.3. Process map: prepare a detailed flow chart showing how data and processes are currently handled.
    - Task 2.4. Identification of inefficiencies: detect areas where the paper-based system fails or could be improved by digitisation.

- Phase 3. Review of each variable and data. Goal: to detail each variable and the data to be recorded in the new system.
    - Task 3.1. Data cataloguing: list all currently collected data, categorising it by type and use.
    - Task 3.2. Review of critical variables: identify critical variables that directly affect patient care.
    - Task 3.3. Norms and standards: ensure that variables comply with national and international medical norms and standards.
    - Task 3.4. Validation with staff: confirm the relevance and accuracy of the variables identified with health care staff.

- Phase 4. Design of the registry in the information system. Goal: to produce a detailed design of how the electronic registry will be structured.
    - Task 4.1. Data modelling: create a data model including tables, fields and the relationships between them.
    - Task 4.2. Defining the user interface: design the user interface (UI), ensuring that it is intuitive and easy to use.
    - Task 4.3. Screen prototyping: create prototypes of the screens to be used for data entry and display.
    - Task 4.4. Review with users: hold review sessions with staff to obtain feedback on prototypes.

- Phase 5. Design of the prototype. Goal: to create a functional prototype of the system.
    - Task 5.1. Prototype development: programme a preliminary version of the system based on the designs approved.
    - Task 5.2. Initial integration: integrate the system components and ensure that they work together.
    - Task 5.3. Internal testing: perform internal testing to identify and correct errors.

- Phase 6. Assessment and creation of connections and interoperability between systems, equipment and devices. Goal: to ensure that the system communicates effectively with other medical systems and devices.
    - Task 6.1. Identification of systems and devices: list all systems and devices with which the new system has to interoperate.
    - Task 6.2. Communication protocols: define the communication protocols (HL7, FHIR, etc.) to be used.
    - Task 6.3. Interface development: programme the interfaces required for interoperability.
    - Task 6.4. Integration testing: perform tests to ensure that the system can communicate correctly with other systems and devices.

- Phase 7. Prototype validation. Goal: to ensure that the prototype meets all requirements and works correctly in a real environment.
    - Task 7.1. User testing: perform tests with real users in a controlled environment.
    - Task 7.2. Feedback collection: collect feedback from users on the performance and usability of the system.
    - Task 7.3. Adjustments and improvements: make adjustments based on the feedback obtained.
    - Task 7.4. Final validation: check that the system meets all requirements and is ready to be implemented.

- Phase 8. Implementation. Goal: to start up the information system in the perfusion and extracorporeal oxygenation department.
    - Task 8.1. Implementation plan: draw up a detailed implementation plan, including a timeline and the resources needed.
    - Task 8.2. Training: train staff in the use of the new system.
    - Task 8.3. Data migration: transfer data from the paper system to the new electronic system.
    - Task 8.4. Deployment: implement the system in the department and ensure that it functions correctly.
    - Task 8.5. Post-implementation support: provide technical support and follow-up to resolve any problems that may arise in the first months of use.

Each one of these phases was crucial to ensuring that the new information system is effective and efficient, and improves the quality of patient care at La Fe Hospital.

RESULTS AND DISCUSSION

Firstly, an exhaustive review of the registration documents and clinical history on paper was carried out (figure 1), together with the data and variables of interest on all the devices and equipment for haemodynamic and respiratory support, monitoring, gasometers and analytical biomarkers.

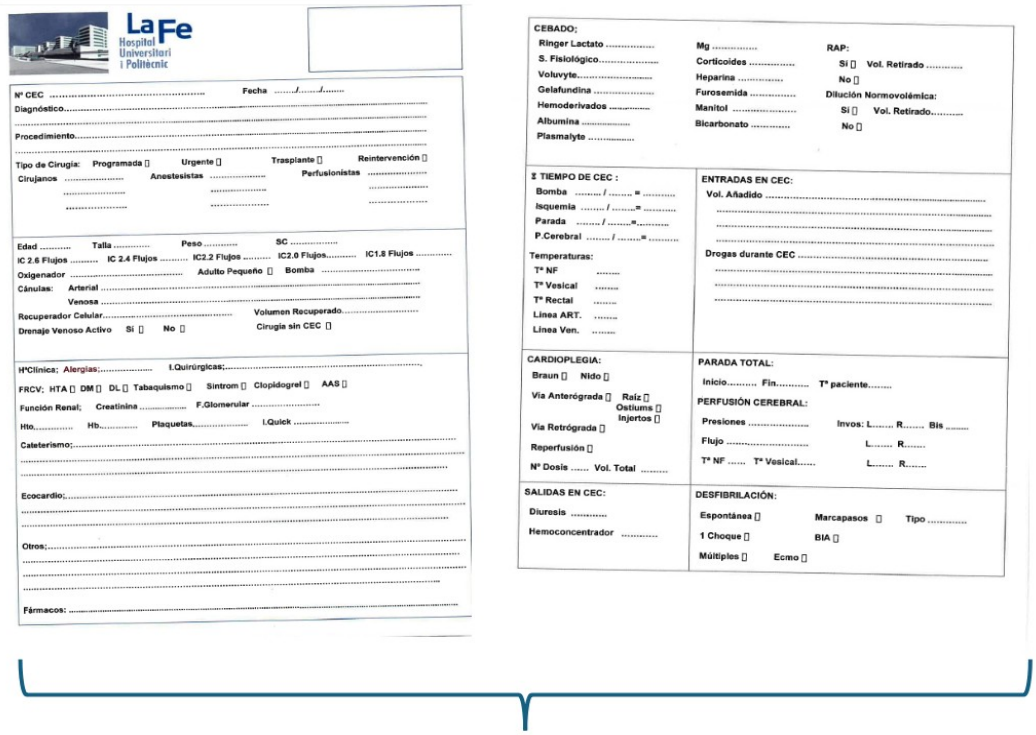

Figure 1: Records on paper.

Based on this, the format of each data was reviewed for digitisation, together with the automated origin of the data if available, and a prototype electronic health record was designed using Philips ICCA software (figure 2).

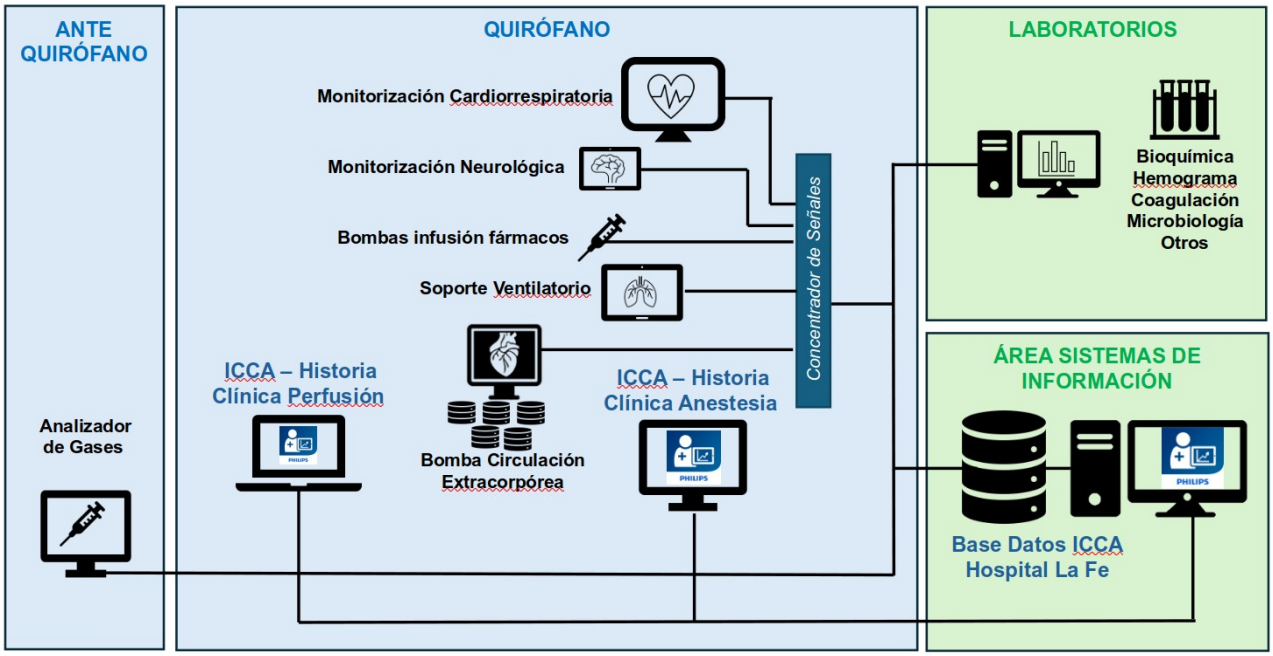

Figure 2: Diagram of the integration of electronic devices and information systems in the surgical area.

This consists of a pre-surgery checklist, a perfusion report that includes all the procedures, the material used, the evolution of the surgery and its completion. There is also a graph that automatically includes the monitoring parameters, data from the respiratory support equipment, data from the extracorporeal circulation pumps, blood gases and biomarker values from the analyses performed during surgery. Water balance calculations have also been automated and a record of drug administration and surgical times has been included (figure 3).

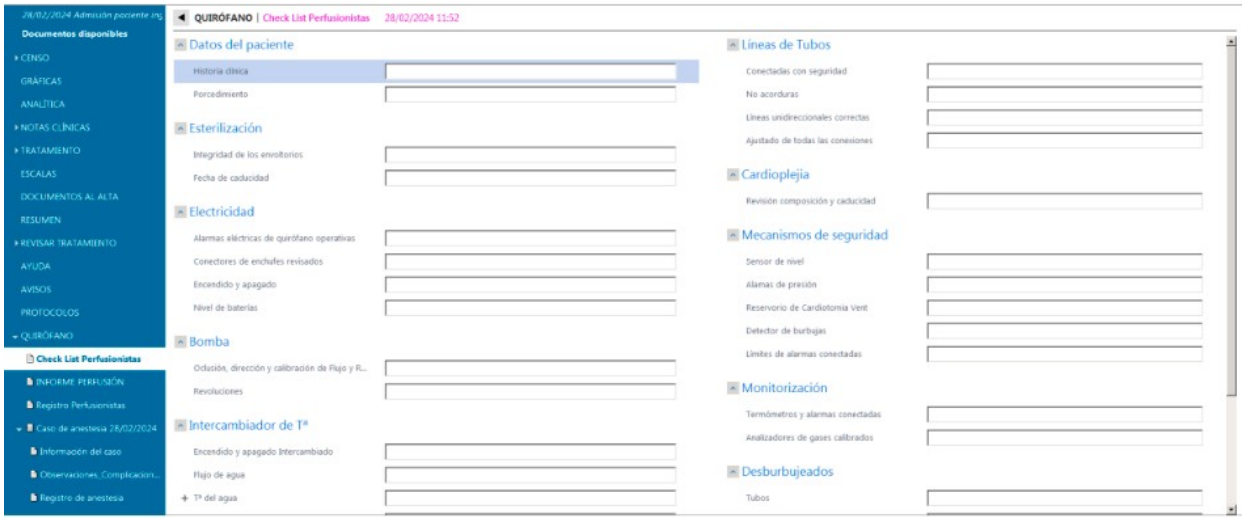

Figure 3: 1 – Electronic records in ICCA. Checklist from before starting extracorporeal surgery.

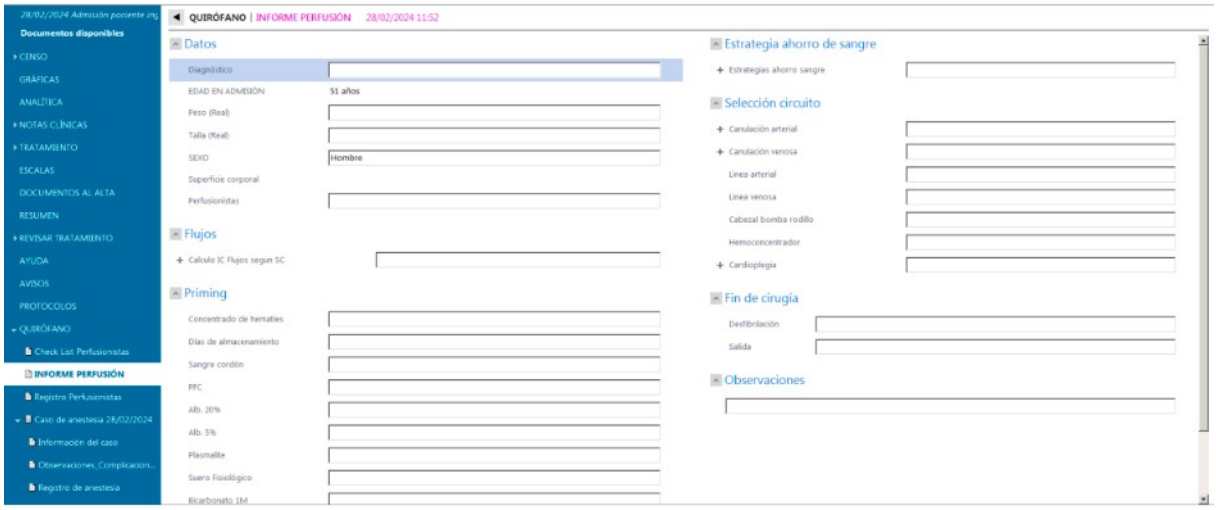

Figure 3: 2 - Electronic records in ICCA. PERFUSION REPORT: collects information on extracorporeal circulation and completion of surgery, as well as allowing observations to be included and the perfusionists responsible for the action to be recorded.

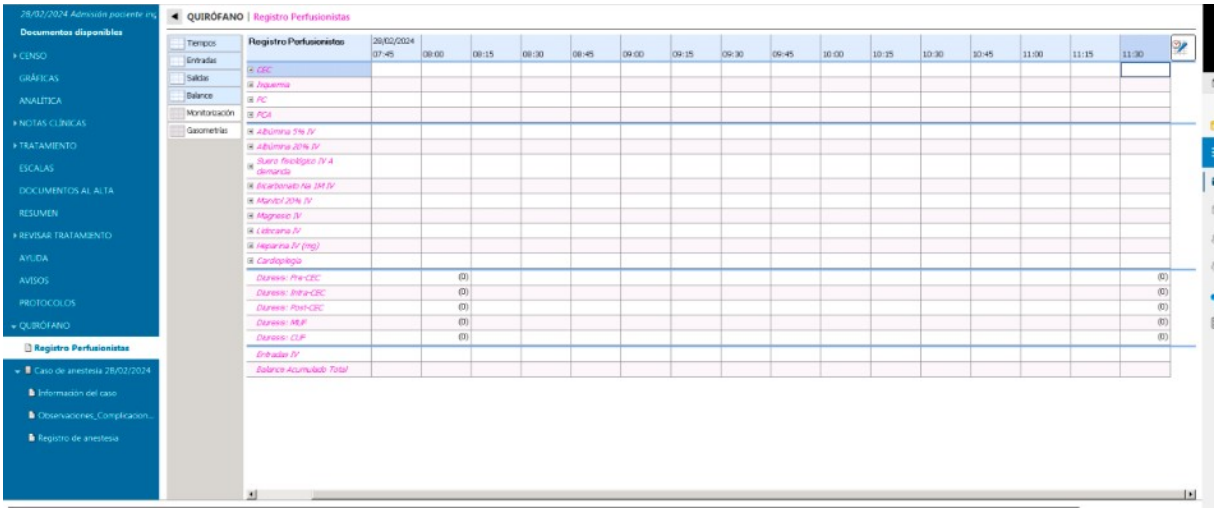

Figure 3: 3A - Electronic records in ICCA. PERFUSIONIST REGISTER: collects information on extracorporeal circulation: TIMES, INPUTS, OUTPUTS, BALANCE, MONITORING and GASOMETRY.

Figure 3: 3B - Electronic records in ICCA. PERFUSIONIST REGISTER: collects information on extracorporeal circulation: TIMES, INPUTS, OUTPUTS, BALANCE, MONITORING and GASOMETRY.

The system is integrated into the hospital's electronic medical records for the surgical area and critical care department, as well as the automated export of files with this information to the regional medical records programme, ORION Clinic. This has made it possible to improve management, optimise the resources allocated, increase patient safety and the quality of care, as automatic calculation formulas have been implemented with predefined criteria according to the type of patient, together with alarms for therapeutic ranges in drugs. It also makes the continuity of care reports between the surgical area, critical care services and hospital departments possible.

In addition, this has led to a reduction in recording time, eliminating duplication, streamlining decision making and thus improving clinical practice and patient safety.

Finally, the unification of the registers in one system by digitising the register with structured data also allows for secondary use of the data, evaluation and ongoing improvement.

CONCLUSIONS

The development and implementation of an integrated electronic register for the perfusion and extracorporeal oxygenation nursing department at La Fe Hospital in the surgical area has facilitated decision-making, improved management, optimised the resources allocated, increased patient safety and the quality of care. It has also made it possible to evaluate the indicators and establish measures for correction and ongoing improvement. There is now also a unified data registry for secondary use in research.

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