engineering proceedings

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Proceeding Paper

Applicability of Clinical Decision Support in Management among Patients Undergoing Cardiac Surgery in Intensive Care Unit: A Systematic Review †

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† Presented at the 4th XoveTIC Conference, A Coruña, Spain, 7–8 October 2021.

Abstract: Advances achieved in recent decades regarding cardiac surgery have revealed a new risk that goes beyond surgeons' dexterity; post-operative hours are crucial in these patients and are usually spent at intensive care units (ICUs), where they need to be continuously monitored to adjust the treatments. Clinical decision support systems (CDSS) have been developed to take this real-time information and provide clinical suggestions to physicians, so as to reduce medical errors and increase patient recovery ratio. In this review, an initial total of 666 papers were considered, finishing with 23 of them after the researchers' filter, which included the deletion of duplications and exclusion if the title and abstract were not of real interest. The review of these papers concludes the applicability and extends the CDSS offer to both doctors and patients. Better prognosis and recovery rate are achieved by using this technology, which also has high acceptance among most physicians. However, despite the evidence that well-designed CDSS are effective, they still need to be refined to offer the best assistance as possible, which may still take time, despite the promising models that have already been applied in real ICUs.

Keywords: clinical decision support; computerized physician order entry; intensive care units; cardiac surgery

Citation: Concheiro-Moscoso, P.; Pereira, M.; Martínez-Martínez, F.J.; Pousada T.; Pereira J. Applicability of Clinical Decision Support in Management among Patients Undergoing Cardiac Surgery in Intensive Care Unit: A Systematic Review. *Eng. Proc.* **2021**, *7*, 24. https://doi.org/10.3390/engproc2021007024

Academic Editors: Joaquim de Moura, Marco A. González and Manuel G. Penedo

Published: 12 October 2021

1. Introduction

Patients who need heart surgery require long stays in intensive care units (ICU), compared to other types of surgery, due to their complications.These patients demand the use of broad resources during their stay, such as high vigilance, quick analysis of parameters or adjustments in their medical treatment. The assistance of vital support for the patients is made through the maintenance of vital signs in a target range, the coordination of early therapy directed by objectives in a cardiogenic shock, and the hemodynamic stabilization of LCOS. These techniques can speed up post-operative recovery, decrease hospital stays or the use of mechanical ventilation, and reduce ICU days. At the ICU, the health experts must carry out the control of these parameters, care for the subjects' needs, and prevent complications by ensuring the optimal state of the patients. The use of clinical decision support (CDS) can be very appropriate, supporting the doctor to improve the clinical progress of the patient. The Computerized Physician Order Entry (CPOE) offers support to avoid errors in the dosages and improve the adjustment according to the patient's

comorbidities. Databases are also an important system in the ICU, because they can enhance learning about the knowledge of the evolution and prevent or act in each clinical situation. Knowing the impact of these tools can improve the health care of cardiac patients in the ICU. This review aims to determine the impact of clinical decision systems on cardiac patients in ICUs.

2. Materials and Methods

2.1. Design of the Study

The authors conducted this review between 2019 and 2020. This review was guided following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement. Relevant studies were selected and analyzed regarding clinical decision support.

2.2. Search Strategy

A search was conducted to find relevant literature published related to alert systems and cardiac patients in the ICU (2010–current). The search was performed on three databases: Pubmed, Web of Science, EBCOS host. This review include only those studies that (1) studied ICU patients of any age with cardiac pathologies and associated problems; (2) analyzed the use of EHRs, CPOE, or MIMIC-III in the data systems' inpatient follow-up; (3) described the combination of CDSSs with previous systems for the improvement of healthcare; (4) provided predictive values for the implementation of these tools in ICUs.

2.3. Study Selection

A total of 666 results were obtained in the literature search, including 629 from the search and 37 from the bibliographies of other studies. After eliminating duplicates, two authors read the titles and abstracts generated by the search strategy independently, but at the same time, for identifying eligible articles and maintaining the consistency in the review. Overall, 283 articles were selected in the first review, whereas 48 were collected in the second review, and finally, 22 results were included.

2.4. Statistical Analysis

Each study was classified according to whether it was a CDSS, CPOE, EHR, or database system, as well as a combination of these decision support systems. On the contrary, the studies were grouped by the measurement of the results.

3. Results

Twenty-two studies met our inclusion criteria. Thirteen studies evaluated the functionality of CDSS in ICUs, three examined the applicability of databases in ICUs, one each studied the usefulness of HER, and CPOE; and four analyzed the function of combination CDSS/CPOE, CDSS/database and CDSS/EHR. The publication dates of these studies ranged from 2006–2018. Eight studies focused on the development and validation of information systems, four studies used retrospective analysis, two studies conducted an experimental design and a controlled trial, and the remaining each were a prospective cohort, performance study, multicenter study, observational cohort research. The results were grouped into six main blocks:

Development forecast: Five studies examined the use of CDSSs as a tool to predict the evolution that patients may have after heart surgery.

Medication errors: Four studies focused on the analysis of the performance of support systems, specifically on the tools applied to CPOE systems in the prevention of errors in the pharmacological treatment of patients in ICUs.

Warning systems: Four studies analyzed the incorporation of CDSSs into surveillance and continuous analysis, to allow the fast detection of clinical alterations.

Standardization and compliance with protocols: Three studies examined the applicability of these tools to help in the implementation of protocols and complex diagnostics.

Precise adjustment to objectives: Six studies analyzed the application of CDSS in clinical practice and how it makes it possible to maintain a constant within a more precise target range.

Cost reduction: Three studies analyzed how the CDSS can contribute to improving the quality and efficiency of patient care and improving patient outcomes, promoting the reduction of health costs.

Acceptance: Four studies report the high acceptance of these support systems in different fields of both treatment and diagnostic acceptance.

4. Discusion and Conclusions

As seen in this review, CDSS have proved themselves to be a complementary tool for treatment that improves life expectancy in a remarkable way. With the decreasing time physicians has for every patient, CDSS may even become substitutes of these professionals when it comes to assist the nursing staff in the tactical decisions, as long as they have been trained successfully through real qualified clinicians' decisions. At intensive care units, this improvement and assistance become fundamental, as one bad decision might have fatal consequences for the patients therein. Besides medical benefits, costs reduction due to CDSS implementation also allows the investment in hospital equipment and the recruitment of more health care workers, which in turn, improves the assistance received by the patients, thus creating a positive feedback in which both workers and patients benefit. However, as with all emerging technologies, these systems need to be tested and refined to offer a life-saving assistance that is as accurate as possible. This still may take some time, but the current available systems suggest the potential of these technologies for health improvement [1].

Author Contributions: The authors contributed to this research article in the following ways: conceptualization, M.P., P.C.-M. and J.P.; methodology, M.P. and P.C.-M.; formal analysis, M.P., P.C.-M., F.J.M.-M., T.P. and J.P.; investigation, M.P., P.C.-M., F.J.M.-M. and J.P.; writing—original draft preparation, M.P., P.C.-M. and F.J.M.-M.; writing—review and editing: T.P. and J.P.; visualization and supervision, all authors; funding acquisition, P.C.-M. All authors read and agreed to the published version of the manuscript.

Funding: The authors disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: All the economic costs involved in the study will be borne by the research team. This work was supported in part by some grants from the European Social Fund 2014–2020. CITIC (Research Centre of the Galician University System) and the Galician University System (SUG) obtained funds through Regional Development Fund (ERDF) with 80%, Operational Programme ERDF Galicia 2014–2020 and the remaining 20% by the Secretaría Xeral de Universidades of the Galician University System (SUG). Specifically, the author PCM obtained a scholarship (Ref.ED481A-2019/069) to develop the PhD thesis. On the other hand, the diffusion and publication of this research was funded by the CITIC, Research Centre of the Galician University System, with the support previously mentioned (Ref ED431G 2019/01).

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The study's data are available to any researcher who contacts the corresponding author, Patricia Concheiro-Moscoso (patricia.concheiro@udc.es).

Conflicts of Interest: The authors declare no conflict of interest.

Reference

1. Pereira, M.; Concheiro-Moscoso, P.; López-Álvarez, A.; Baños, G.; Pazos, A.; Pereira, J. Applicability of Clinical Decision Support in Management among Patients Undergoing Cardiac Surgery in Intensive Care Unit: A Systematic Review. *Appl. Sci.* **2021**, *11*, 2880. [CrossRef]