Strategies for the hospital bed management process: An integrative review

Estratégias para o processo de gerenciamento de leitos em hospitais: Uma revisão integrativa

Estrategias para el proceso de gestión de camas de hospital: Una revisión integrativa

RESUMO

Objetivo: identificar as evidências científicas, disponíveis na literatura, acerca das estratégias para o processo de gerenciamento de leitos em hospitais. Método: trata-se de uma revisão do tipo integrativa, a partir das bases de dados Scopus, Literatura Latino-Americana e do Caribe em Ciências da Saúde, Web of Science e Medline/PubMed, sendo incluídos artigos publicados entre os anos de 2016 e 2022, utilizando estratégias de busca específicas para cada base. Dos estudos encontrados, foram selecionados 14 para análise. Resultados: As estratégias para o processo de gerenciamento de leitos em hospitais abarcam os seguintes temas gerais: técnicas de modelagem de simulação; implantação da gestão interna de leitos hospitalares e utilização de sistemas da informação. Conclusão: As estratégias sugeridas para o processo de gerenciamento de leitos, têm a intenção principal de auxiliar os gestores nas tomadas de decisão, tendo em vista que o tema engloba um conjunto de processos com grande complexidade.

DESCRITORES: Administração Hospitalar; Ocupação de Leitos; Acesso aos serviços de saúde. Hospitais.

ABSTRACT

Objective: to identify the scientific evidence, available in the literature, about the strategies for the bed management process in hospitals. Method: this is an integrative review, based on Scopus, Latin American and Caribbean Literature in Health Sciences, Web of Science and Medline/PubMed databases, including articles published between 2016 and 2022, using specific search strategies for each base. Of the studies found, 14 were selected for analysis. Results: Strategies for the bed management process in hospitals cover the following general themes: simulation modeling techniques; implementation of internal management of hospital beds and use of information systems. Conclusion: The strategies suggested for the bed management process have the main intention of helping managers in decision-making, considering that the theme encompasses a set of highly complex processes.

DESCRIPTORS: Hospital Administration; Occupation of Beds; Access to health services. Hospitals.

RESUMEN

Objetivo: identificar las evidencias científicas, disponibles en la literatura, sobre las estrategias para el proceso de gestión de camas en hospitales. Método: se trata de una revisión integradora, basada en las bases de datos Scopus, Literatura Latinoamericana y del Caribe en Ciencias de la Salud, Web of Science y Medline/PubMed, que incluye artículos publicados entre 2016 y 2022, utilizando estrategias de búsqueda específicas para cada base. De los estudios encontrados, 14 fueron seleccionados para el análisis. Resultados: Las estrategias para el proceso de gestión de camas en hospitales abarcan los siguientes temas generales: técnicas de modelado de simulación; implementación de gestión interna de camas hospitalarias y uso de sistemas de información. Conclusión: Las estrategias sugeridas para el proceso de gestión de camas tienen la intención principal de auxiliar a los gestores en la toma de decisiones, considerando que el tema engloba un conjunto de procesos de alta complejidad.

DESCRIPTORES: Administración Hospitalaria; Ocupación de Camas; Acceso a los servicios de salud. hospitales.

RECEBIDO EM: 07/10/2022 **APROVADO EM:** 07/11/2022

Fernanda Barreto Meneses Pessoa Lima
Pharmaceutical. Master's student in Health Management and Innovation at the Federal University of Rio Grande do Norte, Natal, Rio Grande do Norte, Brazil. Health Management Analyst at the Brazilian Company of Hospital Services, Salvador, Bahia, Brazil.
ORCID: 0000-0001-7807-2512

Heleni Aires Clemente
Nutritionist. Doctor in Nutrition. Adjunct Professor at the Federal University of Rio Grande do Norte, Natal, Rio Grande do Norte, Brazil.
ORCID: 0000-0002-2180-6754

DOI: https://doi.org/10.36489/saudecoletiva.2023v13i84p12362-12383

Albenize de Azevêdo Soares
Nurse. Master's student in Collective Health. Federal University of Rio Grande do Norte, Natal, Rio Grande do Norte, Brazil.
ORCID: 0000-0002-3008-0043

Gabriel Lucas de Castro Cunha
Undergraduate student in Pharmacy at the University of Brasília, Brasília, Federal District, Brazil.
ORCID: 0000-0003-1968-0029

Thiallan Nery Faustino
Nurse. Master's student in Health Management and Innovation at the Federal University of Rio Grande do Norte, Natal, Rio Grande do Norte, Brazil. Works at Maternidade Climério de Oliveira, Salvador, Bahia, Brazil.
ORCID: 0000-0002-5357-1937

José Adailton da Silva
Nurse. PhD in Collective Health. Professor of the Graduate Program in Health Management and Innovation at the Federal University of Rio Grande do Norte, Natal, Rio Grande do Norte, Brazil.
ORCID: 0000-0002-6037-7649

INTRODUCTION

The universalization of health services described by the Unified Health System (SUS) has proved to be fragile, mainly due to the rationalization of resources and the irregular dimensioning of hospital beds, causing inequalities in the inclusion of the population in public health care. [1] SUS patients had 11,938 fewer beds in the public hospital network, considering the period from 2008 to 2013. [2] In this context, bed management is a fundamental strategy for distributing hospital beds in an equitable and transparent manner, with a view to improving hospital performance in different dimensions. [3]

In this area, it is clear that one of the biggest challenges in hospitals is the bed management process, due to the difficulty of reconciling the increase in demand with the existing installed capacity, as well as distributing beds according to the complexity of each case, so that the patient receives the right care, at the right place and time, for as long as necessary. [4]

Since the 1980s, the bed management process has been discussed in Brazil, initially from the perspective of defining the sociodemographic profile of those who benefited from hospitalization and measuring the productivity of hospitals through some indicators, such as length of stay. [5] This process has expanded worldwide in the last decade, as managers and researchers seek improvements through the use of management tools, in order to preserve the balance between the entry and exit of patients in hospitals, aiming to maintain bed occupancy rates. [6]

In Brazil, it is observed the difficulty of the Federal University Hospitals (HUF) of the Ebserh Network in maintaining their occupancy rates at the level recommended by the Ministry of Health, whose ideal goal is to have an index around 80 to 85%. [7] According to data obtained through filters performed by the TABWIN/TABNET tools, the average rate of occupancy of beds at the HUF in 2021 is around 59.25%. [8] It was also found that the behavior of the occupancy rate between 2012 and 2017 is systematically below 75% in the Ebserh Network hospitals in Manaus, Goiânia, and one in Rio de Janeiro. [9]

The lack of effective bed management implies cancellations of elective surgeries, delays in admitting patients from the emergency room and hospital discharges, in addition to a greater risk of allocating patients to inappropriate beds, without considering the level of criticality, causing serious problems involving different areas of the hospital. [10]

Thus, it is clear how important and complex the study of the hospital bed management process is, which ranges from the development of information systems for monitoring and planning hospital occupancy to the elaboration of operational processes for admission, monitoring of therapy and hospital discharge. [11]

Therefore, the need for research on this process to assist hospital managers in decision-making is evident. Given this scenario, this study aims to identify the scientific evidence available in the literature about strategies for the bed management process in hospitals.

METHOD

This research used an integrative literature review as a method, which aims to gather and synthesize knowledge, in a systematic and orderly manner, in addition to allowing the incorporation of the applicability of results from significant studies in practice. [12]

The methodological course of the research was subdivided into six phases: identification of the theme and selection of the hypothesis or research question, establishment of criteria for inclusion and exclusion of studies/sampling or literature search, definition of the information to be extracted from the selected studies/categorization of the studies, evaluation of the studies included in the integrative review, interpretation

DOI: https://doi.org/10.36489/saudecoletiva.2023v13i84p12362-12383

and discussion of the results and presentation of the synthesis of knowledge. 13

The identification of the theme and the research question was carried out according to the PICO strategy, being P: population – hospital managers, I: phenomenon of interest – identification of the bed management process in hospitals, C: context – hospital organization. From this, the following guiding question was elaborated: "Which strategies related to the bed management process in hospitals are available in the literature?".

The survey of publications took place between October and November 2022 in the databases Scopus, Latin American and Caribbean Literature in Health Sciences (LILACS), Web of Science, Medline/PubMed, limits were established regarding the year of publication, which was comprised between 2016 and 2022, regarding open access and availability of the full text. The journal portal of the Coordination for the Improvement of Higher Education Personnel (CAPES) was used, with recognition at the Federal University of Rio Grande do Norte (UFRN) in order to obtain a broader search for the research, due to the availability of articles beyond the open access modality.

For the refinement of the articles, the following inclusion criteria were established: articles published in Portuguese, Spanish and English and that met the objective of the research. The application of the inclusion criteria was made by two researchers independently, obtaining a Kappa index equal to 1 (K=1.0). Editorials, letters to the editor, abstracts, expert opinion, other reviews, correspondence, reviews, book chapters, theses, dissertations and repeated articles that did not meet the proposed objective were excluded.

To choose the descriptors to be used in the search, consultations were carried out in the Health Sciences Descriptors (DeCS) and in the Medical Subject Headings (MeSH), and keywords were used in order to locate a greater number of evidences. Considering the specificities of the databases, different search strategies were used for each of them, with the review question and inclusion criteria as the guiding principle (Chart 1).

For the selection of articles, with the aim of ensuring greater reliability to the study, the recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) were used, according to the flowchart in Figure 1. PRISMA consists of a checklist of 27 essential points to guide the study in a clear and detailed way, which can also be viewed in a flowchart with all the study development phases, also accompanied by an explanatory and exemplified document. [4]

RESULTS

The review consisted of 14 articles that describe the scientific evidence about the strategies for the bed management process in hospitals. A summary of the articles included in the integrative review is presented in Table 2 below, containing the following information: title, author/year, Country, journal/base, objective, summary results. This table was created with a view to analyzing the relevant information to achieve the objective of the review, in a descriptive way, in order to contextualize the evidence extracted to answer the review question.

DISCUSSION

According to the extraction of evidence from the selected manuscripts, it can be seen that bed management is a subject discussed worldwide, despite the fact that most of the publications found are national. It is noted that the strategies for the bed management process in hospitals cover the following general themes, which will be detailed below: simulation modeling techniques; implementation of internal management of hospital beds; use of information sys-

Chart 1 - Search strategies used on strategies for the bed management process in hospitals. Natal, Rio Grande do Norte, Brazil, 2022

Bases	Search strategies
SCOPUS, WEB OF SCIENCE e MEDLINE/PUBMED	"Bed management" AND "Hospitals" "Bed Occupancy" AND "Hospitals" "Flow of Patients" AND "Hospitals"
LILACS	("Bed management" OR "Gerenciamento de leitos" OR "Gestão de leitos" OR "Manejo de la cama") AND ("Hospitais" OR "Centro Hospitalar" OR "Centros Hospitalares" OR "Nosocômio" OR "Nosocômios" OR "Hospitals OR Hospital" OR "Hospitales") ("Ocupação de Leitos" OR "Bed Occupancy" OR "Occupancies, Bed Occupancy, Bed" "Ocupación de Camas") AND ("Hospitais" OR "Centro Hospitalar" OR "Centros Hospitalares" OR "Nosocômio" OR "Nosocômios" OR "Hospitals OR Hospital" OR "Hospitales") ("Fluxo de Pacientes" OR "Flow ofPatients" OR "Flujo de pacientes") AND ("Hospitais" OR "Centro Hospitalar" OR "Centros Hospitalares" OR "Nosocômio" OR "Nosocômios" OR "Hospitals OR Hospital" OR "Hospitales")

Source: Authors, 2022

DOI: https://doi.org/10.36489/saudecoletiva.2023v13i84p12362-12383

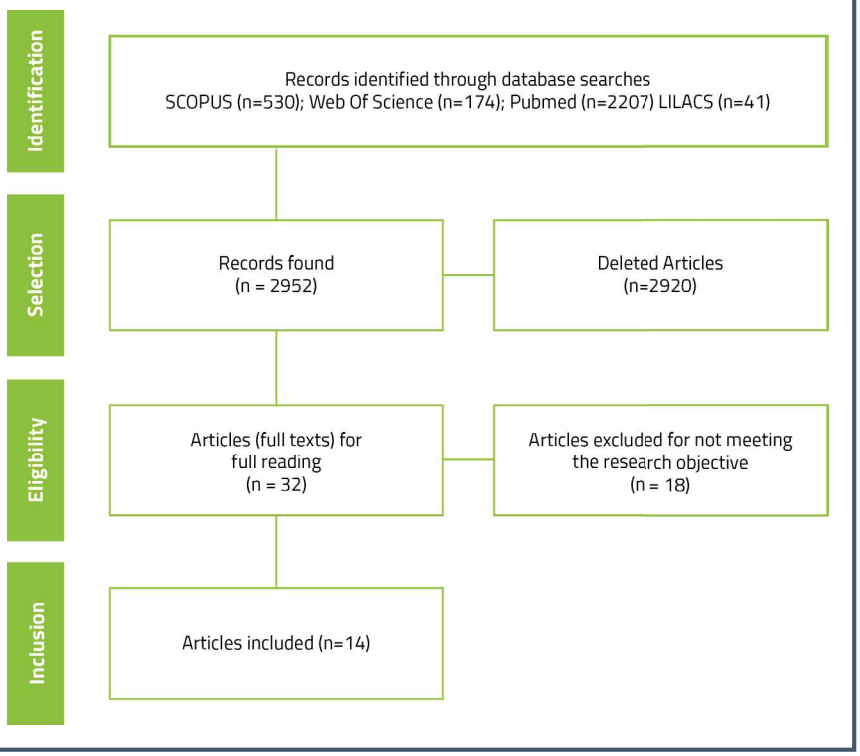
tems (IS).

Simulation modeling techniques

Simulation modeling techniques are playing an increasing role in supporting healthcare-related decision-making processes. Discrete Event Simulation (DES) is a modeling technique that aims to comprehensively compare practices, in order to identify the most efficient and effective ones, in order to model complex systems in which it may be impracticable to carry out research or comparative experiments in reality. [19]

In a study carried out in Poland, the possibilities of using the DES to support decision-making in the field of hospital bed management in the light of demographic changes were observed. The DES performed to simulate hospitalizations in two wards was effective in demonstrating that demographic changes can influence the admission of health care and the definition of bed use, being an important tool for decision-making.[25] Thus, DES can be used to examine a specific hospital with dynamic changes

Figure 1 – Flowchart of the selection process, eligibility and inclusion of articles in the integrative review. Natal, Rio Grande do Norte, Brazil, 2022



Source: adapted by the authors, 2022.

Chart 2: Synthesis of articles included in the integrative review, 2022.

Title	Author / Year / Country	Journal - Base	Objective	Synthesis of the Results
Software development for bed management in urgency and emergency (Desenvolvimento de software para gerenciamento de leitos na urgência e emergência)	Oliveira et al., 2021.15 - Brazil	Revista Brasileira de Enfermagem - SCOPUS	To describe the process of developing a software for bed management in urgency and emergency.	The CuidarTech KRONOS software, which uses the kanban methodology, would improve the management of urgent and emergency beds, as it would facilitate the visualization of hospitalized patients, in addition to having a database to generate reports with hospital indicators, helping professionals and managers to make decisions.
Symbiotic simulation for the operational management of inpatient beds: model development and validation using Δ–method.	Oakley; Onggo; Worthington, 2020.16 - United Kingdom	Health Care Management Science - SCOPUS	To investigate important issues associated with the development and use of symbiotic simulation decision support systems in the context of operational management of inpatient beds.	The benefit of symbiotic simulation was verified in relation to its use as an early warning system and as a post-admission patient information system, helping hospitals with short-term operational decisions in the context of inpatient bed management. Furthermore, they proposed a new Δ method that is suitable for validating a stochastic symbiotic simulation model.
Operational patient-bed assignment problem in large hospital settings including overflow and uncertainty management.	Schäferet al., 2019.17 - Germany	Flexible Services and Manufacturing Journal - SCOPUS	Propose a new modeling approach and solution to the bed allocation problem for elective and emergency inpatients, taking into account the specific objectives of the interested parties.	The modeling approach and the developed solution provide improvements in bed allocations for each patient, based on the dataset available at admission, taking into account the objectives of the interested parties, namely: patients, nurses and physicians.

DOI: https://doi.org/10.36489/saudecoletiva.2023v13i84p12362-12383

A decision support simulation model for bed management in healthcare.	Cudneyet al., 2019.18 - USA	International Journal of Health Care Quality Assurance - SCOPUS	Develop a discrete event simulation (DES) to assist in decision making and team planning for bed management.	DES allowed hospital administrators to analyze the hospital's operational behavior in relation to changes in resources, length of stay, and bed turnover times.
Multiobjective bed management considering emergency and elective patient flows.	Landaet al., 2018.19 - Italy	International Transactions in Operational Research - SCOPUS	To study a hospital's bed management function in order to develop a discrete event simulation (DES) model to represent elective and emergency admissions in inpatient wards.	It was found that the SED model developed for the flows of emergency and elective patients, based on the multiobjective optimization approach, it can be used as a support tool for decision makers, helping them to find different solutions for bed management at an operational and tactical level, without the need to increase bed capacity. The method allowed examining several operational strategies to improve the flow of patients from the emergency room to other hospital wards without increasing bed capacity.
Near real-time bed modelling feasibility study	Englandet al., 2021.20 - United Kingdom	Journal of Simulation - SCOPUS	Highlight the usefulness of a short-term bed planning tool in a Trauma and Orthopedics department of a busy Welsh hospital.	The bed planning tool combined discrete event simulation (DES) and traditional forecasting which provided an operational (short term) solution for department managers planning inpatient services.
Bed management team with Kanban web-based application	Lima et al., 2018.21 - Brazil	International Journal for Quality in Health Care - SCOPUS	Measure the effectiveness of the bed management process that uses a web-based application with Kanban methodology to reduce the length of stay of hospitalized patients.	The bed management process using an electronic tool based on the Kanban methodology was effective in reducing the length of stay of patients. There was an increase in the control of the bed management process after the implementation of the tool, considering that there was a reduction in the average length of stay in all hospital beds, mainly the beds in the intensive care units and the average length of stay, in addition to reducing customer dissatisfaction
Bed management in a hospital center of the Jequitinhonha expanded health region: organizational and operational aspects of the work process (Gestão de leitos em um hospital polo da região ampliada de saúde Jequitinhonha: aspectos organizacionais e operacionais do processo de trabalho)	Souza et al., 2020. 22 - Brazil	Journal of Health & Biological Sciences. Revista de Saúde e Ciências Biológicas - LILACS	To describe the organizational and operational aspects of the bed management work process at a hospital in the Jequitinhonha Expanded Health Region	The implementation of bed management in the hospital proved to be an important tool to provide significant changes in the institution, such as improvements in indicators, work processes and communication between professionals, ensuring better care for hospitalized patients.
The implementation of the Internal Regulation Center in a Tertiary Public Hospital: The experience of the Hospital das Clínicas of the Faculty of Medicine of Ribeirão Preto, University of São Paulo (A implantação do Núcleo Interno de Regulação em Hospital Público Terciário: A experiência do Hospital das Clínicas da Faculdade de Medicina de Ribeirão Preto da Universidade de São Paulo)	Ferreira, et al., 2019.23 - Brazil	Journal: Medicina (USP.FMRP) - LILACS	Evaluate the level of implementation of the Internal Regulation Nucleus (IRN) in two units of a tertiary public hospital complex.	The IRN is an important management tool for the development of processes within hospitals, so it is recommended to establish a policy for the implementation of IRNs with the monitoring of their development.
Analysis of the Hospital Regulatory Internal Nuclei of a capital city (Análise dos Núcleos Internos de Regulação hospitalares de uma capital)	Soares, 2017. 24 - Brazil	Einstein (São Paulo) - LILACS	Evaluate the composition of Internal Regulation Centers established in hospitals in a capital city.	The IRNs, in the evaluated experiences, were a very promising management tool for promoting the efficient use of beds, mainly in relation to the reduction of the average length of stay, with adequate and safe rotation of beds for patients.

DOI: https://doi.org/10.36489/saudecoletiva.2023v13i84p12362-12383

Simulation modelling for predicting hospital admissions and bed utilisation.	Hajłasz, et al., 2020. 25 - Poland	Operations Research and Decisions - WEB OF SCIENCE	Show the possibilities of using discrete event simulation (DES) to support decision making in the field of hospital bed management in light of demographic changes.	The DES performed to simulate hospitalizations in two wards was effective in demonstrating that demographic changes can influence the admission of health care and the use of beds, being an important tool for decision-making in relation to bed management.
Internal Center for Hospital Regulation: repercussions of implementation on health service indicators. - (Núcleo Interno de Regulação hospitalar: repercussões da implantação nos indicadores dos serviços de saúde.)	Feijó Et al., 202226 - Brazil	Revista Latino-Americano de Enfermagem - WEB OF SCIENCE	Evaluate hospital indicators and their repercussions, before and after the implementation of the Internal Regulation Center, on the number of monthly hospitalizations in a public teaching hospital.	With the implementation of the IRN, there were significant improvements in the results of hospital production indicators: number of hospital discharges, bed occupancy rate, bed renewal rate, average hospital stay, hospital infection and infant mortality rates, demonstrating that the IRN constituted an innovative management strategy with relevant contributions to the health service.
Information Technology in support of Bed Management: A Multicase Study in Private Hospitals. - (A Tecnologia da Informação no apoio à Gestão de leitos: Um Estudo Multicaso em Hospitais Privados.)	Raffa, Malik, Pinochet, 201727 - Brazil	Revista Administração em Diálogo - WEB OF SCIENCE	Identify the relationship of Information Technology in supporting bed management, with regard to the performance of systems, in the perception of managers, in reference to private hospitals in the city of São Paulo.	Of the five private hospitals surveyed, one was considered the most productive, which uses information systems as a facilitating tool in the bed management process, since it monitors all stages of the process, in addition to providing monitoring of the stipulated goals, helping managers in decision-making.
Discrete-Event Simulation Modeling of Critical Care Flow: New Hospital, Old Challenges.	Williams Et al., 202028 - United Kingdom	Critical Care Explorations - PUBMED	Develop a discrete event simulation (DES) model to determine the optimal number of intensive care beds by simulating different hypothetical scenarios.	Of the five private hospitals surveyed, one of them was considered the most productive, which uses systems of With the use of SED, it was possible to discover that it is necessary to increase the number of beds for intensive care, and that reducing the proportion of intensive care patients who are delayed in discharge has a greater effect in reducing occupancy levels than simply increasing the number of beds, even when demand increases.

Source: Authors, 2022

taking place at the time. [29]

Also from this perspective, in another study carried out in the United States, Cudneyet. al. [18] (2019) show the development of a DES to assist in decision-making and team planning for bed management, allowing hospital administrators to analyze the hospital's operational behavior in relation to admissions, patient transfers, length of stay, waiting time, and average patient queue time. In this study, SED was chosen because it allows experimenting with scenarios to efficiently model hospital units, in order to improve bed management and quantify the impact on the overall system. The main results presented were considerable improvements in patient waiting time in the queue, average number of patients in the queue and average length of stay, from the reduction of bed turnover time by 1 hour.

DES can also be used to minimize emergency room overcrowding through proper allocation of beds between hospital wards. [30] It was found that the SED model developed for the flows of emergency and elective patients, based on the multiobjective optimization approach, can be used as a support tool for decision makers, helping them to find different solutions for bed management at an operational and tactical level, without the need to increase bed capacity. [19]

Still, from the perspective of predicting the arrival of patients in order to optimize the distribution of beds, a study carried out in Germany found a new modeling approach and solution for the problem of bed allocation for elective and emergency hospitalized patients. Thus, the article shows models for flexible bed allocations, and anticipation of future arrivals of elective and emergency patients, based on the dataset available at admission, taking into account the objectives of the interested parties: patients, nurses and physicians. With the application of the modeling approach, a reduction in the time that patients remain in the emergency room and an increase in the proportion of patients occupying a bed was observed due to the proposed adjustments in patient-bed allocations. [17]

In another study carried out in a UK hospital, a DES model was developed to determine the ideal number of intensive care beds simulating different hypothetical scenarios. As the demand for this type of bed increases each year, it is clear that the DES was important in this study to analyze scenarios in order to determine the effects of the increase in capacity, increased demand and reduced rate and duration of late transfer of

DOI: https://doi.org/10.36489/saudecoletiva.2023v13i84p12362-12383

care when patients are ready to be discharged from the intensive care unit. It was found that it is necessary to increase the number of intensive care beds, and that reducing the proportion of intensive care patients who are delayed in discharge has a greater effect in reducing occupancy levels than simply increasing the number of beds, even when demand increases. Applying a DES model is a more modern form of management and produces more accurate and visual results than those performed using spreadsheets. [29]

There are some limitations on the use of SED, for Oakley, Onggo and Worthington [16] (2020) the tool is often restricted to strategic or tactical decision-making, and in this study they tried to produce models that can help hospitals in making short-term (operational) decisions. Therefore, they developed a symbiotic simulation using an existing hospital unit model, in addition to proposing a new method, called Δ, which is suitable to validate a stochastic symbiotic simulation model. The benefit of symbiotic simulation was verified in relation to its use as an early warning system and as a post-admission patient information system, helping hospitals with short-term operational decisions in the context of inpatient bed management.

Furthermore, from the point of view of solutions at the operational level, the study by England et al. [20] highlights the usefulness of a short-term bed planning tool in a Trauma and Orthopedics department of a busy Welsh hospital. The tool combined SED and traditional forecasting which provided an operational solution for Trauma and Orthopedic department managers who plan inpatient services. It is concluded that the event simulation model can be used as a decision support tool for bed management.

Regarding the applicability of the DES in Brazil, no significant studies were found within the scope of bed management, according to the selected articles. However, it is understood that simulation modeling could, for example, be used in the Ebserh Network, which is composed of 40 Federal University Hospitals (HUF), bearing in mind that the comparability of practices between these hospitals would be enriching, in order to identify the most efficient and effective ones to be applied throughout the Network. These hospitals are complex systems, which makes it difficult to carry out comparative research or experiments in reality, thus, the development of a DES to assist managers in decision-making and bed management planning would allow administrators of these hospitals to analyze the system without interrupting the flow of activities in the real system. Given this, it is clear that the DES would be very useful to HUF managers, because in addition to allowing a complete visualization of the systems at high cost, it would be possible to visualize the results even before its implementation.

In view of the analyzed literature, the benefits of using simulation modeling stand out, especially with regard to the ability to imitate real systems and implement different scenarios, with a relatively low cost compared to other methods. In this sense, it is clear that the DES has been widely used in healthcare management, but one of the challenges of using this method is to correctly verify and validate the model.

Implementation of internal management of hospital beds

The issue of internal management of hospital beds in Brazil usually occurs after the implementation of the Internal Regulation Center (IRN). [31] At an international level, this specific nomenclature is not used, but it is evident in the studies analyzed, which consider the implementation of bed management as a tool for the hospital which corroborates the purpose considered for the IRN, in accordance with the National Hospital Care Policy (PNHOSP), established through Ordinance No. 3390/2013, consolidated by Consolidation Ordinance GM/MS No. 2/2017, of the Ministry of Health. [32]

The theoretical concept of an IRN, according to the ordinance, is comprehensive and includes everything from providing outpatient consultations and diagnostic support services to the management of hospital beds, according to pre-established criteria for care. The PNHOSP in its article 11, paragraph 6, states that:

> Bed management will be carried out from the perspective of integrating clinical practice in the hospitalization and discharge process, preferably through the implementation of an Internal Regulation Center (IRN) or Hospital Access and Quality Center (NAQH - Núcleo de Acesso e Qualidade Hospitalar), with the aim of increasing bed occupancy and optimizing the use of installed capacity, improving user service.

Thus, the IRN seeks to optimize the use of the hospital's installed capacity, through bed management, as it establishes a protocol with hospitalization criteria, defines the service profile, and allocates the right patient to the right bed. [19] The activity of establishing a protocol with hospitalization criteria, defining the service profile, so important for bed management, is being expanded to work with medical care teams in some hospitals, evolving beyond the administrative tasks associated with patient admission. [24]

According to Soares [24], who evaluated the composition of IRN instituted in hospitals in a Brazilian capital, whose main motivations for their creation were legal issues and overcrowding in the emergency sector, the main function of the IRN is to promote the efficient and rational use of hospital beds. For this, new patients must be admitted only after confirmation of the existence of vacant beds and support for the transport of the patient who will use the bed, in addition to operational processes defined for discharge. The study hi-

DOI: https://doi.org/10.36489/saudecoletiva.2023v13i84p12362-12383

ghlights that the IRN, in the evaluated experiences, it was a very promising management tool that brought significant results in several indicators related to bed management, such as reducing the average length of stay and increasing the occupancy rate, providing adequate and safe bed rotation for patients.

Furthermore, in the study by Feijo et al. ,[26] which evaluated hospital indicators and their repercussions, before and after the implementation of the IRN in a public university hospital in Brazil, it was found that there were significant improvements in the results of hospital production indicators: number of hospital discharges, bed occupancy rate, bed renewal rate, average hospital stay, hospital infection and infant mortality rates, demonstrating that the IRN constituted an innovative management strategy with relevant contributions to the health service.

Another study, similar to the previous one, which evaluated the level of IRN implementation in two units of a public hospital complex in Brazil, highlights that IRN is an important management tool for the development of processes within hospitals, therefore, it is recommended to establish a policy for the implementation of the IRN with objective references that can be scored, allowing the monitoring of its development. [23]

In view of the importance of policies for the implementation of IRN, the Ministry of Health prepared the IRN Implementation and Implementation Manual in 2017, which provides guidance to hospital managers regarding the best conduction in the IRN implementation process, in accordance with the legislation in force. This manual presents guiding guidelines for implementation, a proposal for constituting the IRN team, as well as guidelines for carrying out the internal management of beds, in addition to technical subsidies for carrying out actions that qualify care, based on the information arising from the monitoring of bed management carried out through indicators. [3]

Currently, bed management is considered an important tool for improving patient flow. In the study by Souza et. al. [22] which describes the organizational and operational aspects of the bed management work process in a hospital in Brazil, demonstrates that the implementation of bed management was an important tool to provide significant changes in the institution, such as improvements in indicators, in work processes and communication between professionals, ensuring better care for hospitalized patients. In this study, as well as from the perspective of international studies, bed management was used comprehensively as a tool for internal bed management and not personalization through the IRN.

A very relevant aspect addressed in this study is that the implementation of bed management provided improvements in the communication of health professionals. Communication between health teams can take on several interfaces that can cause discomfort and conflict if not well managed, and these interfaces will depend on the organization of services. [23] Thus, the organization of services proposed with the implementation of bed management has become indispensable since the failures in communication between health professionals have been one of the main factors that contribute to the decrease in the quality of care provided to the patient. [33]

Regarding the applicability of the IRN in Brazil, the experience of the Ebserh Network can be mentioned, in which all HUF have IRN implanted, acting quite successfully, considering that it is a unit responsible for the organization of the entrance door, with patient management in the hospital, in addition to extra-hospital activities, involving counter-referral. According to the data obtained from the Maturity Assessment Program in Regulation and Health Assessment (PRO-REG), whose objective is to prioritize actions for structuring and qualifying the regulatory processes of hospitals in the Ebserh Network, in 2021, all hospitals declared to have IRN linked to the Regulation Sector, which monitor indicators related to hospitalization that are fundamental for bed management. [34] The IRN in the HUF have a fundamental role because they act in the organization of access to the services offered by the hospitals, as well as ensuring the integrality of the care through the interface with the management of the care.

Thus, through the evaluated studies, it is clear that the implementation of the internal management of hospital beds, either through the IRN, a nomenclature usually used in Brazil, or through the management of beds, at an international level, it is a useful strategy for the development of actions to maximize the use of beds, in order to increase the turnover within technical criteria, aiming to reduce the length of stay, in addition to optimizing the hospital's installed capacity and qualifying the service to the user.

Use of Information Systems (IS)

In the studied scenario, it is noteworthy that information systems have become indispensable for work processes in the health area. Information technology is essential for providing information in real time for planning care, directing care and providing accurate information. [23]

The study by Raffa, Malik and Pinochet [27], carried out in reference private hospitals in the city of São Paulo demonstrated that the use of information systems as a tool has helped managers in decision-making because it facilitates access to information in real time, collaborating in solving problems in order to obtain improvements in the quality of care and reduction of health risks. Of the five hospitals surveyed, one of them was considered the most productive, which uses information systems as a facilitating tool in the bed management process, as it monitors all stages of the process, in addition to providing follow-

DOI: https://doi.org/10.36489/saudecoletiva.2023v13i84p12362-12383

-up on the stipulated goals.

According to Oliveira et al.[15] the development of information systems is essential for managing beds, especially for real-time monitoring of various indicators and for planning hospital occupancy. In the study, research was carried out in a teaching hospital in Brazil, where the Cuidar Tech KRONOS software was developed to manage urgent and emergency beds, using the kanban methodology. In this research, the implementation of the software in the hospital would provide improvements in bed management since it would facilitate the visualization of hospitalized patients in real time, allowing the identification of the reasons for the stay. With this, the software, when generating reports with hospital indicators, would help professionals and managers in decision-making, as well as improvements in the quality of patient care and reduction of costs with hospitalizations.

Kanban was developed in Toyota's Japanese factories in the 1950s, initially to control production and material flow, and since then, it has been adapted to improve the effectiveness of several processes, including in the health area. [35] In the hospital context, Kanban is used as a tool that monitors the length of stay of patients admitted to the beds of hospital care units, through color signaling, aiming at improving patient flow. [36]

Also from this perspective, in a study carried out in Brazil, in a highly complex hospital with 300 beds, it was observed that the bed management process using a web-based application with Kanban methodology was effective in reducing the length of stay of patients. [21] According to Lima et al. [21] there was a reduction in the average length of stay before and after the intervention in all hospital beds, especially beds in intensive care units. It was also possible to observe a decrease in length of stay, with a stable trend over time, where only the bed management intervention with Kanban was decisive.

In this context, it is perceived that the use of information systems can help in the management of beds, considering that this tool facilitates the collection, storage, retrieval, monitoring and dissemination of information in real time providing improvements in the quality of patient care. [15] Using data that is often readily available in bed management tracking systems, a hospital's operational behavior can be modeled, which allows hospital management to test the impact of changes without cost and risk. [18]

Since the 1980s, the bed management process has been discussed in Brazil, initially from the perspective of defining the sociodemographic profile of those who benefited from hospitalization and measuring the productivity of hospitals through some indicators, such as length of stay.

On the other hand, the lack of access to detailed data available in information systems forces hospitals to adopt manual strategies that, unfortunately, can lead to distortion and errors in some parameters that generate the information. Furthermore, in the case of DES, the aforementioned simulation modeling technique, it is often impossible to verify various scenarios and their real sequences without the help of information systems. [25] Thus, it is imperative that hospitals have information systems to obtain reliable data aimed at improving bed management and patient flow.

The development of these systems is complex and needs to involve professionals from the areas where the system will be implemented, in order to be consistent with the demands of the service. [15] For the successful implementation of a computerized system, there is a need for the commitment of all levels of professionals, from strategic to operational.

Given this, it is clear that the development and construction of information systems for bed management must be guided by the integration between the areas of health and information technology.

In Brazil, it is clear that management information systems are still outdated from a technological point of view. This outdatedness can generate an immense amount of problems, both from the point of view of management, operation and hospital cost, as well as the poor quality of patient care. In this way, the incorporation of information systems in hospitals contributes significantly to the management of activities as a whole, especially in relation to bed management, which covers activities from admission to discharge of patients.

CONCLUSION

Bed management is a complex service that involves all areas of the hospital and encompasses activities ranging from patient admission to discharge. In this sense, it is important to deepen the know-

DOI: https://doi.org/10.36489/saudecoletiva.2023v13i84p12362-12383

ledge about strategies that can be used for the milky management process in order to facilitate the work of managers aiming at the continuous improvement of patient flows in the hospital.

The articles studied demonstrate that, from the point of view of simulation modeling techniques, these proved to be efficient for the management of beds, helping managers in decision-making since it becomes possible to imitate possible realities, as well as monitoring changes in a system at a specific time, with relatively low costs compared to other techniques.

Within the scope of the implementation of the internal management of hospital beds, the incipience of the IRN in the Brazilian health system is conceived, despite this, it is shown in the research to be an efficient management tool for optimizing beds and patient flows, providing significant results in several indicators related to bed management. In addition, the equivalence of IRN attributions was verified, despite the scope of activities being somewhat broader, with bed management at an international level.

Regarding information systems, it is observed that their objective is to store, process and provide information in an agile, safe and more reliable way to support an organization's processes. Therefore, it is essential for managers to use these systems in decision-making in order to assist them in the development of strategies and new workflows in order to increase the turnover of patients in bed and consequently the efficiency of bed management and reduction of hospital costs.

It is necessary to consider that the strategies suggested for the bed management process have the main intention of assisting managers in decision-making, considering that the theme encompasses a set of highly complex processes. The use of such strategies will provide a deeper understanding of the bed management process and the flow of hospital patients, in order to obtain advances in work processes and in the quality of services provided to patients.

Finally, as a limitation of the research, there was a lack of studies related to the theme. Although the number of articles was high in the selection, only 14 articles answered the guiding question, which demonstrates that the topic is relevant, but needs to be deepened in the field of health.

The study recognizes that bed management is a management tool for improving hospital performance in different dimensions, so improvements should be sought in order to qualify the process. In this sense, it is recommended that future work be carried out for the development of more research that encompasses efficient conducts for the management of beds in hospitals.

REFERÊNCIAS

1.Machado DC, Machado ACA. A otimização do processo de gerenciamento de leitos e alta hospitalar. Saúde Coletiva (Barueri). 2020;9(50):1866–72. https://doi.org/10.36489/saudecoletiva.2019v9i50p1866%20-%201872

2. Associação Nacional dos Hospitais Privados (ANAHP). Livro Branco Brasil Saúde 2015: a sustentabilidade do sistema de saúde brasileiro: caderno de Propostas. São Paulo: ANAHP; 2015.

3. Brasil. Ministério da Saúde. Secretaria de Atenção à Saúde. Departamento de Atenção Hospitalar e de Urgência. Manual de implantação e implementação: Núcleo Interno de Regulação para Hospitais Gerais e Especializados [recurso eletrônico] Brasília: Ministério da Saúde, 2017.

4. Cerdeira AKLA, Hekis HR. SisperaH: Sistema Inteligente de Gestão de Lista de Espera Hospitalar: regulação de leitos, lista de espera, gestão e inovação em saúde [Internet]. [Rio Grande do Norte]: Universidade Federal do Rio Grande do Norte; 2020 [cited 2022 Out 28]. Availablefrom: https://repositorio.ufrn.br/handle/123456789/31857

5. Nascimento AB. Gerenciamento de leitos hospitalares: análise conjunta do tempo de internação com indicadores demográficos e epidemiológicos. Revista de Enfermagem e Atenção à Saúde. 2015;4(1):65–78. https://doi.org/10.18554/

6. Boaden R, Proudlove N, Wilson M. An exploratory study of bed management. J Manag Med. 1999;13(4–5):234–50. https://doi.org/10.1108/02689239910292945

7. Brasil. Ministério da Saúde (BR). Agência Nacional de Saúde Suplementar. Taxa de Ocupação Operacional Geral [Internet]. Brasília: Ministério da Saúde; 2012 [cited 2022 Out 28]. Available from: https://www.gov.br/ans/pt-br/arquivos/assuntos/prestadores/qualiss-programa-de-qualificacao-dos-prestadores-de-servicos-de-saude-1/versao-anterior-do-qualiss/e-efi-01.pdf

8.Brasil. Ministério da Saúde (BR). Secretaria Executiva. DATASUS [recurso eletrônico] [Internet]. Brasília: Ministério da Saúde. 2021 [cited 2022 Out 28]. Availablefrom: https://datasus.saude.gov.br/

9.AndreazziMFS, Gomes LS, Pérez MA, Azevedo NRP, D'Almeida LVS. Um olhar exploratório sobre hospitais universitários federais selecionados segundo modelos de gestão de 2012 a 2017. Rev. Gest. Sist. Saúde, 2021; 10(3), 238-252. https://doi.org/10.5585/rgss.v10i3.17204.

10. Grübler MDS, Costa CA, Righi RDR, Rigo SJ, Chiwiacowsky LD. A Hospital Bed Allocation Hybrid Model Based on Situation Awareness. CIN - ComputersInformaticsNursing. 2018;36(5):249–55. https://doi.org/10.1097/CIN.0000000000000000421

11. Machado RM, Lima SBS de, Costa VZ da, Venturini L, Streck MTH. Implementation and operationalization of the internal center for hospital regulation: Integrative review. Research, Society and Development. 2021;10(6):e30210615836. https://doi.org/10.33448/rsd-v10i6.15836

DOI: https://doi.org/10.36489/saudecoletiva.2023v13i84p12362-12383

12. Souza MT, Silva MD, Carvalho R. Revisão integrativa: o que é e como fazer. einstein (São Paulo). 2010;8(1):102–6. https://doi.org/10.1590/S1679-45082010RW1134

13. Sousa LMMS, Marques-Vieira CMA, Severino SS, Antunes AV. Metodologia de Revisão Integrativa da Literatura em Enfermagem. Revista Investigação Enfermagem [Internet]. 2017 [cited 2022 Out 12];21: 17–26. Availablefrom: https://repositorio-cientifico.essatla.pt/handle/20.500.12253/1311?mode=full

14. Fuchs S, Soldateli B. Revisão Sistemática de Estudos Observacionais com Metanálise. Clinical and Biomedical Research [Internet]. 2010 [cited 2022 Out 8];30(3):294-301. Available from: https://seer.ufrgs.br/hcpa/article/view/16551

15.Oliveira IS, Lima EFA, Silva RIC, Figueiredo KC, Dias ICB, Primo CC. Desenvolvimento de software para gerenciamento de leitos na urgência e emergência. Revista Brasileira de Enfermagem. 2021 Mar 15;74(74Suppl 5):e20200055. https://doi.org/10.1590/0034-7167-2020-0055

16.Oakley D, Onggo BS, Worthington D. Symbiotic simulation for the operational management of inpatient beds: model development and validation using Δ-method.Health Care Management Science [Internet]. 2020 [cited 2022 dez 12];23(1):153–69. Available from: https://link.springer.com/article/10.1007/s10729-019-09485-1

17. Schäfer F, Walther M, Hübner A, Kuhn H. Operational patient-bed assignment problem in large hospital settings including overflow and uncertainty management. Flexible Services and Manufacturing Journal [Internet]. 2019 [cited 2022 Nov 8];31(4):1012–41. Available from: https://link.springer.com/article/10.1007/s10696-018-9331-0

18.Cudney EA, Baru RA, Guardiola I, Materla T, Cahill W, Phillips R, et al. A decision support simulation model for bed management in healthcare. International Journal of Health Care Quality Assurance [Internet]. 2019;32(2):499–515. https://doi.org/10.1108/IJHCQA-10-2017-0186

19.Landa P, Sonnessa M, Tànfani E, Testi A. Multiobjective bed management considering emergency and elective patient flows. International Transactions in Operational Research [Internet]. 2018[cited 2022 Nov 8];25(1):91–110. Available from: https://onlinelibrary-wiley.ez18.periodicos.capes.gov.br/doi/full/10.1111/itor.12360

20. England T, Gartner D, Ostler E, Harper P, Behrens D, Boulton J et al. Near real-time bed modelling feasibility study. Journal of Simulation. 2021; 15(4): 261-272. https://doi.org/10.1080/17477778.2019.1706434

21. Lima Rocha HA, da Cruz Santos AKL, de Castro Alcântara AC, da Costa Lima CSS, Maia Oliveira Rocha SG, Cardoso RM, et al. Bed management team with Kanban web-based application. International Journal for Quality in Health Care. 2018;30(9):708–14. https://doi.org/10.1093/intqhc/mzy108

22. Souza D, Souza DM, Vasconcelos BF, Viana DMS, Ribeiro LCC, Lima AMJ. Gestão de leitos em um hospital polo da região ampliada de saúde Jequitinhonha: aspectos organizacionais e operacionais do processo de trabalho. Journal of Health & Biological Sciences. 2020;8(1):1–5. http://dx.doi.org/10.12662/2317-3076jhbs.v8i1.2819.p1-5.2020

23. Ferreira AJ, Laurindo MC, Morais AAL, Cerantola R, Barbosa LB, Cruz JHGP, et al. A implantação do Núcleo Interno de Regulação em Hospital Público Terciário. Medicina (Ribeirão Preto). 2019;52(1):16–23. https://doi.org/10.11606/issn.2176-7262.v52i1p16-23

24. Soares VS. Analysis of the Internal Bed Regulation Committees from hospitals of a Southern Brazilian city. einstein (São Paulo). 2017;15(3):339–43. https://doi.org/10.1590/S1679-45082017GS3878

25. Hajłasz M, Mielczarek B. Simulation modelling for predicting hospital admissions and bed utilisation. Operations Research and Decisions. 2021;30(3):5–19. https://doi.org/10.37190/ord200301

26.Feijó VBER, Barreto MFC, Tanita M, Balsanelli AP, Cunha ICKO, Haddad MCFL. Internal Regulation Center in hospitals: Repercussions of its implementation on the health services' indicators. Rev. Latino-Am. Enfermagem. 2022;30:e3517.http://dx.doi.org/10.1590/1518-8345.5700.3517

27. Raffa C, Malik AM, Pinochet LHC. A Tecnologia da Informação no Apoio à Gestão de Leitos: Um Estudo Multicaso em Hospitais Privados. RevistaAdministraçãoemDiálogo - RAD. 2017;19(3):1–23. https://doi.org/10.23925/2178-0080.2017v19i3.31356

28. Williams, E., Szakmany, T., Spernaes, I., Muthuswamy, B., & Holborn, P. Discrete-Event Simulation Modeling of Critical Care Flow: New Hospital, Old Challenges. Critical care explorations. 2020; 2(9), e0174. https://doi.org/10.1097/CCE.0000000000000174

29. Landa P, Sonnessa M, Tànfani E, Testi A. A discrete event simulation model to support bed management. Simultech2014 - Proceedings of the 4th International Conference on Simulation and Modeling Methodologies, Technologies and Applications [Internet]. 2014 [cited 2022 Nov 8]; Available from: https://doi.org/10.5220/0005161809010912

30. Holm LB, Lurås H, Dahl FA. Improving hospital bed utilisation through simulation and optimisation: With application to a 40% increase in patient volume in a Norwegian general hospital. International Journal of Medical Informatics. 2013;82(2):80–9. https://doi.org/10.1016/j.ijmedinf.2012.05.006

31. Rodrigues LCR, Juliani CMCM. Impact of implementing an Internal Bed Regulation Committee on administrative and care indicators at a teaching hospital. einstein (São Paulo). 2015;13(1):96–102.https://doi.org/10.1590/S1679-45082015GS3235

32. Brasil. Ministério da Saúde (BR). Consolidação das normas sobre as políticas nacionais de saúde do Sistema Único de Saúde – Portaria de consolidação no 2 de 28 de setembro de 2017. [Internet]. Diário Oficial da União (DOU) 2017 [cited 2022 Nov 8]. Availablefrom: https://bvsms.saude.gov.br/bvs/saudelegis/gm/2013/prt3390_30_12_2013.html

33. Bagnasco A, Tubino B, Piccotti E, Rosa F, Aleo G, di Pietro P, et al. Identifying and correcting communication failures among health professionals working in the Emergency Department. InternationalEmergencyNursing. 2013;21(3):168–72. https://doi.org/10.1016/j.ienj.2012.07.005

34. Brasil. Ministério da Educação (BR). Empresa Brasileira de Serviços Hospitalares. Diretoria de Ensino, Pesquisa e Atenção à Saúde. Programa de Avaliação de Maturidade em Regulação em Saúde:PRO-REG [recurso eletrônico] [Internet]. Brasília: Ministério da Educação 2019 [cited 2022 Nov 8]. Availablefrom: https://www.gov.br/ebserh/pt-br/acesso-a-informacao/boletim-de-servico/sede/2020/anexos/programa-de-avaliacao-de-maturidade-em-regulacao-pro-reg.pdf/view

35. Beaulieu M, Landry S. Achieving lean healthcare by combining the two-bin kanban replenishment system with RFID technology. International Journal of Health Management and Information (IJHMI) [Internet]. 2010 [cited 2022 Nov 9];1(1):85–98. Availablefrom: https://www.researchgate.net/publication/284670162

36. Aparecida I, Massaro C, Massaro A. O uso do KAN BAN na gestão do cuidado: superando limites. Revista de Administração em Saúde [Internet]. 2017 Jan 17 [cited 2022 Nov 9];17(66). Availablefrom: https://cqh.org.br/ojs-2.4.8/index.php/ras/article/view/14/27

DOI: https://doi.org/10.36489/saudecoletiva.2023v13i84p12362-12383