JAFF

Jornal de Assistência Farmacêutica e Farmacoeconomia
v.9, n.1, 2024.
Original Article

Drug unitarization in a large hospital of Distrito Federal: a pharmacoeconomic analysis

Unitarização de medicamentos em um hospital de grande porte do Distrito Federal: uma análise farmacoeconômica

Isabela B. Cosma de Souza[1], Ana V. Neves de Oliveira[2], Camila Alves Areda[3], Rinaldo E. Machado de Oliveira[3], Antônio L. de Freitas Garcia[4]

[1] Pharmacist at the University of Brasília, Ceilândia Faculty, Brasília - DF, Brazil.
[2] Pharmacist, Resident in Urgent and Emergency Care, Antônio Dias Regional Hospital, Patos de Minas - MG, Brazil.
[3] Adjunct Professor at the University of Brasília, Ceilândia Faculty, Brasília - DF, Brazil.
[4] Specialist Pharmacist in Sanitary Surveillance, University of Brasília, Ceilândia Faculty, Brasília - DF, Brazil.

Corresponding Author:
isa.cosma@gmail.com

How to cite this article:
Souza IBC, Oliveira AVN, Areda CA, Oliveira REM, Garcia ALF. Drug unitarization in a large hospital of Distrito Federal: a pharmacoeconomic analysis. J Assist Farmac Farmacoecon; 9(1): 18-25, Jan. 2024. doi: 10.22563/2525-7323.2024.v9.n.1.p.18-25e

Received: 09/29/2023

ABSTRACT

Objectives: This aimed to do an analysis of the drug unitarization process in a large hospital of Distrito Federal, from a pharmacoeconomical perspective. **Methods:** This is an observational, retrospective, and descriptive study. It was realized a bibliographic research and a data survey from the local Pharmacotechnical Laboratory, from January 2020 to August 2022. The processes and steps that the medicines went through, from the entry into the hospital up to their distribution, were tracked and registered using a flowchart created with the BizAgi Process Modeler tool. **Results:** It was verified that the implementation of the unitarization process was simple and low-cost to the hospital; There was a significant cost reduction regarding alteplase; as well as a saline and other drugs waste reduction, in addition to a shortage decrease to methylprednisolone. It was found that the records of the unitarization and dispensing processes adopted by the institution aren't capable yet to secure all the needed traceability to the medicines. Despite that, the unitarization is financially feasible and can reach savings of up to US$38,821.92 regarding only one of the drugs, in the appraised period. **Conclusions:** The pharmacoeconomics impact was positive and the unitarization process led to better results than the drug's use in its commercial presentations, by reducing possible waste and the possibilities of shortage of the analyzed drugs, improving patient's safety, and expanding access to the medicines. These results are compatible with other findings available in the literature that attests to the viability of the unitarization process.
Keywords: Medication Systems; Pharmacy Service, Hospital; Tissue Plasminogen Activator; Economics, Pharmaceutical; Cost-Benefit Analysis; Methylprednisolone.

RESUMO

Objetivos: Objetivou-se analisar a unitarização de medicamentos em um hospital de grande porte do Distrito Federal na perspectiva farmacoeconômica. **Métodos:** Trata-se de estudo observacional, retrospectivo e descritivo. Foi realizada pesquisa bibliográfica e levantamento de dados no laboratório de farmacotécnica local, entre janeiro de 2020 e agosto de 2022. Os processos e etapas percorridos pelos medicamentos desde a entrada no hospital até a distribuição, foram averiguados e registrados por meio de fluxograma criado com a ferramenta *BizAgi Process Modeler*. **Resultados:** Verificou-se que a implementação da unitarização foi simples e de baixo custo para o hospital. Houve também redução de custos no caso da alteplase, redução no desperdício de soro fisiológico, e demais medicamentos, bem como controle e diminuição do desabastecimento quando avaliado a metilprednisolona. Constatou-se que os registros dos processos de unitarização e dispensação adotados, ainda não são capazes de garantir toda a rastreabilidade dos medicamentos. Ainda assim, a unitarização é financeiramente viável, podendo chegar a uma economia de até US$ 38,821.92 com apenas um medicamento, no período avaliado. **Conclusões:** O impacto farmacoeconômico mostrou-se positivo e a unitarização conduziu aos resultados superiores à utilização dos medicamentos em suas apresentações comerciais por reduzir eventuais desperdícios e apresentar melhoria na segurança do paciente, ampliação do acesso, bem como, redução da possibilidade de desabastecimento. Este resultado corrobora o de outros estudos disponíveis na literatura, que atestam a viabilidade da unitarização.
Palavras-chave: Sistemas de Distribuição de Medicamentos em Doses Unitárias, Serviço de Farmácia Hospitalar, Ativador de Plasminogênio Tecidual, Farmacoeconomia, Análise Custo-Benefício, Metilprednisolona.

Introduction

According to the Resolution of the Collegiate Board No. 67 of 2007, from the National Health Surveillance Agency (ANVISA), the unit dose preparation of medications is the process carried out under the responsibility of a pharmacist or under their guidance, which aims at the subdivision of a pharmaceutical form or transformation of these into stable, pre-established unit doses, preserving their quality and traceability[1]. This preparation is only allowed in pharmacies providing services within a hospital unit or an equivalent medical care facility[1].

Its application primarily occurs in the Unit Dose Medication Distribution System (SDMDU), one of the main methods of pharmaceutical distribution in the hospital environment, where medications are delivered in doses and forms ready to be administered to the patient, following the medical prescription[2].

Previous studies have shown that this type of distribution not only results in savings in the final medication expenses per patient but also reduces the time spent by the nursing staff, considering that they do not need, for example, to perform dose calculations. Thus, it can be presumed that this expected reduction in expenses in the SDMDU paves the way for an increase in the time and quality of patient care, expanding the number of individuals attended to and their access to medications.[3-4]

Another point to consider regarding the unit dose preparation is how this process is closely linked to the rational and safe use of medications, precisely because it ensures that they reach the patient in the correct dose, providing greater safety without room for excess. This is not limited to the hospital setting but also applies to home use.[3-4]

Studies show that the SDMDU is the safest distribution model for patients. However, it is still underutilized in Brazilian hospitals.[4] In this context, it is necessary to conduct research investigating the particularities of the implementation and impacts of this system. According to Silva Souza and collaborators, there is a clear economic advantage in implementing the SDMDU, especially when considering long-term data.[2]

Objectives

The objective was to analyze the unit dose preparation of medications in a large hospital in the Federal District from a pharmacoeconomic perspective and to assess whether there was a reduction in shortages or changes in public access to these medications with the unit dose.

Methods

This is an observational study based on a survey of available literature data on unit dose medications, as well as data from the pharmaceutical technology laboratory of the hospital responsible for the unit dose preparation, compiled through spreadsheets sent by the responsible pharmacist. It is a retrospective and descriptive study concerning the use and costs of medications from January 2020 to August 2022.

The literature search utilized the Google Scholar tool with the following search strategy: ((Unit Dose Medication Distribution Systems) AND (Hospital Pharmacy Service) AND (Cost Reduction) AND (unit dose) AND (rational use of medications)), with a publication date filter from 2017 to 2022, yielding 487 results. This search tool was employed as it provided more viable results for analysis.

The results obtained were then screened for applicability to the sought theme by reading the titles, excluding internship reports, conference proceedings, and symposium publications. Subsequently, abstracts were read to further select suitable results to support this work, resulting in a total of 37 selected articles, which were read in full, and those with greater thematic congruence were chosen. In addition to these, other references found through active searching were also utilized.

The information gathered from this search was used in constructing references and analyzing the results obtained from this study.

According to information released by the Communication Agency of the Department of Health of the Federal District in 2019, the hospital analyzed in this study has 464 beds and 32 outpatient specialties, and can be classified as a large hospital.[5-6]

The processes involved in the implementation of unit dose preparation were mapped, and based on this, a flowchart was created using the BizAgi Process Modeler,[7] which allows for mapping and documenting executed processes, enabling the assessment of the need for improvements and increasing organizational efficiency.

Data regarding the implementation of unit dose preparation in the hospital, as well as the available infrastructure and any changes, were also collected through reports from the pharmacist responsible for the process, to better understand the costs involved in this installation process, in addition to data on the methodologies employed in both the recording and actual manipulation.

Although the financial values were recorded in Brazilian Reais, they were converted to American dollars, using the average daily closing exchange rates obtained from the Central Bank of Brazil's website.[8] After calculating these averages, only numbers up to the second decimal place were used for conversion. The preparation of such conversions considered the commercial dollar rates at the buying quote. The average exchange rate determined was R$5.15 for the year 2020, R$5.39 for the year 2021, and R$5.16 for the year 2022.

The study utilized publicly accessible data and did not involve human subjects. Therefore, it was exempt from submission to the Research Ethics Committee/National Commission for Ethics in Research system, in accordance with the ethical considerations of Resolution No. 510 of 2016[9] from the National Health Council.

Results

The implementation of the unit dose preparation process was simple and low-cost for the hospital, due to the repurposing of a space and infrastructure previously allocated to parenteral nutrition, which had been idle, and was then transferred for unit dose preparation. Since this space and its equipment were constructed and acquired previously for another purpose, there is no available information regarding their actual value, and no further modifications to this structure were necessary.

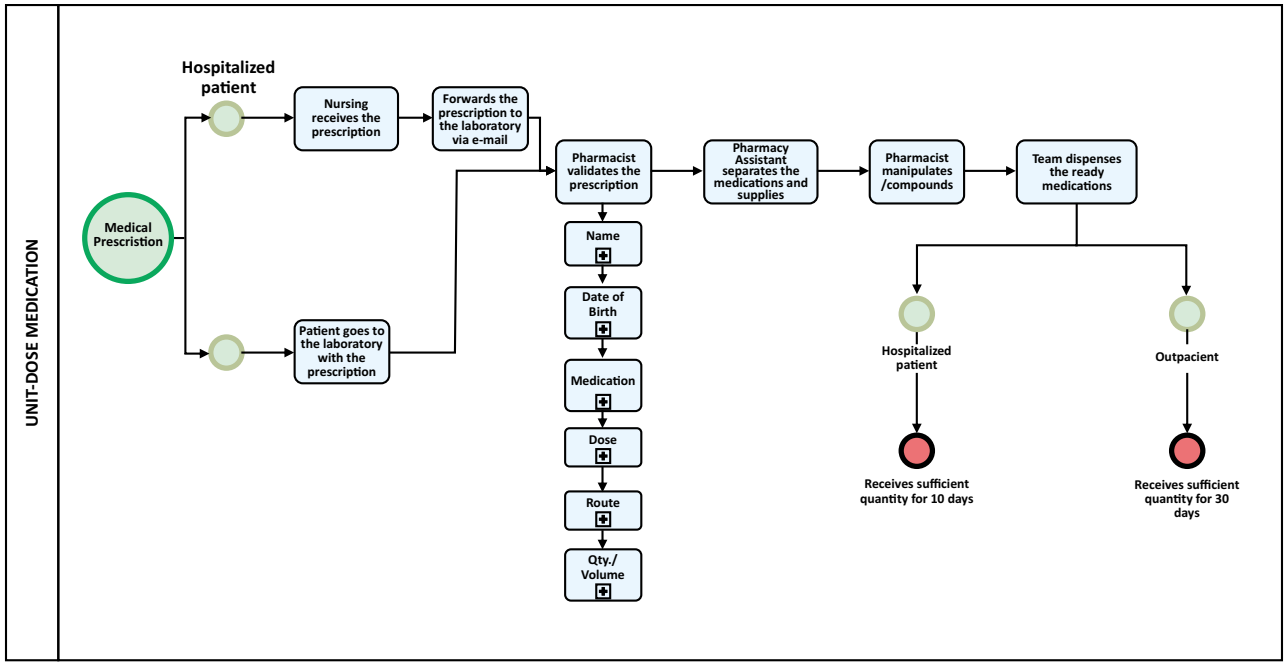
The unit dose preparation processes occur in two different ways, divided for outpatient and inpatient patients. For inpatients, the physician first prescribes in the system, the nursing staff sends this prescription to the email of the pharmaceutical technology laboratory, where the team of pharmacists evaluates it, and the medication is prepared in sufficient quantity for ten days. The nursing staff then collects the medications from the preparation area and distributes them. For outpatient services, the patient brings the prescription, the pharmacist performs the evaluation, calculates and creates the labels, records it in the spreadsheet, and then prepares a quantity of medication sufficient for 30 days, with this process being carried out on the same day. However, data regarding the impacts of outpatient care were not evaluated. This mapping can be visualized in Figure 1.

Data from the unit dose preparation of the medications alteplase, methylprednisolone, and saline solution, conducted by the pharmaceutical technology laboratory of the analyzed hospital, were analyzed.

The 0.9% saline solution in 500 mL is used for washing the PICC catheter in infants and by physiotherapists for washing aspiration probes after respiratory physiotherapy. Before the implementation of this process, the guidance from the neonatal ICU nursing team was to open one vial per shift. Since the hospital operates three shifts, at least three vials would be opened each day, regardless of the amount used, with the remaining contents of the vial needing to be discarded at the end of each shift. With the unit dose preparation and filling in five or ten milliliter syringes, this quantity of vials is not wasted, as only the necessary amount for each patient is utilized.

Methylprednisolone was widely used during the COVID-19 pandemic due to the "COVID kits," and consequently faced supply shortages throughout the Federal District. The hospital had stock that, considering the daily usage routine, would be sufficient for one month. In order to avoid compromising patient access to this medication and to extend the capacity for care with the available stock, unit dose preparation in syringes was initiated, which consequently extended the estimated service period to three months.

Figure 1. Flowchart of the mapping process for the unit dose preparation of medications.



Source: Created by the authors using the BizAgi tool.

Alteplase is used in the hospital for two purposes: in ischemic events (such as acute myocardial infarction and pulmonary thromboembolism), and off-label for the declogging of catheters. The unit dose preparation, in this case, would address the second demand.

The first step in implementing the unit dose preparation process for alteplase was to contact the nephrology nursing team to understand the usage profile, which involved opening a vial whenever there was a need to declog a catheter for patients undergoing hemodialysis, using the necessary amounts to treat the patients of the day and discarding the remaining volume once the stability period described by the manufacturer had passed.

With this information, a literature search was conducted for data that would support the practice of unit dose preparation, allowing for a more rational use of this medication, avoiding waste, and enabling the use of a reconstituted vial for a period exceeding the 24-hour stability guaranteed in the package insert.[10]

It was found that the reconstituted solution, with a concentration of 1 mg/mL of alteplase, maintains its thrombolytic activity for up to six months if stored at a temperature of -20°C or lower[11].

Despite the guaranteed physical-chemical stability and thrombolytic activity, RDC No. 67 of 2007 only allows for unit dose products to be stored for a maximum of 60 days[1]. The Hospital Infection Control Commission (CCIH) of the institution recommended that unit doses be stored for a period of up to 30 days to ensure microbiological safety.

The catheter used by patients undergoing hemodialysis who received the unit doses is of the Permcath® type, which, according to literature searches conducted by the hospital team and empirical testing, has a lumen of 5 mL, making this the volume adopted as the standard dosage to be prepared in syringes.

The Table 1. contains the amounts paid by the Department of Health for a 50 mg vial of alteplase and for the unit dose, according to information provided by the relevant health service.

The Table 2. shows the volume of unit doses prepared, in milliliters, month by month from January 2020 to August 2022. Analyzing the obtained information, it is possible to calculate that 208 doses (1,040 mL) were prepared in the year 2020, 313 doses (1,565 mL) in the year 2021, and by August 2022, 350 doses (1,750 mL) had been prepared.

Table 1. Amounts paid by SES-DF for alteplase 50mg.

Period	Amount per vial	Cost per unit dose
2020	US$ 376.51	US$ 37.65
2021	US$ 413.75	US$ 41.37
2022	US$ 432.19	US$ 43.21

Source: Pharmacotechnical Laboratory of the studied hospital.

Table 2. Volume of alteplase (in mL) unitized in the years 2020, 2021, and 2022, by month

Year/Month	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
2020	100mL	100mL	50mL	95mL	50mL	50mL	50mL	170mL	225mL	100mL	0mL	50mL
2021	150mL	50mL	175mL	100mL	100mL	175mL	195mL	120mL	100mL	100mL	100mL	200mL
2022	100mL	200mL	350mL	100mL	200mL	300mL	300mL	200mL	-	-	-	-

Source: Pharmacotechnical Laboratory of the studied hospital.

It is evident that unit dose preparation is not an infallible process, as there may be losses during manipulation. A 50 mg vial is diluted in 50 mL, resulting in a theoretical yield of ten doses. In some months, the volume of doses produced does not reach this theoretical yield, resulting in a total volume that is not a multiple of ten.

Based on this information, there is a noticeable trend of increasing the number of unit doses prepared year after year, but it is not possible to compare pre- and post-implementation consumption data, since in 2019, prior to the implementation, the nephrology department operated with only two shifts, and in 2020, the same year that unit dose preparation began, an additional shift was added. Therefore, it is not possible to assert that any variation in consumption is due to the unit dose preparation practice itself.

For other unit doses, such as methylprednisolone, the same situation persists. Although a longer duration and a theoretical saving are noted, it was not possible to estimate the actual savings due to issues with underreporting.

The Pharmaceutical Technology Laboratory uses two distinct methodologies for recording the processes executed. To document the production of unit doses, Excel spreadsheets are used, which compile the quantity of syringes manipulated. Regarding the documentation related to prescriptions, medical reports, and requests from the nursing team that reflect the actual distribution and dispensing of doses, this is done analogically, with records on printed paper stored in a physical file.

In 2022, the year in which prescriptions and nursing requests related to unit dose preparation were found with fewer gaps, there was an average of seven patients per month requiring catheter declogging and 33 syringes distributed for this purpose. The average dose per patient is five syringes.

If all these patients needed to use alteplase in a single day, the medication consumption, considering the average dose used for each patient, would be 175 mL, utilizing four 50 mg vials, at a cost ranging from US$ 1506.04 to US$ 1728.76. These values represent the minimum and maximum prices observed between 2020 and 2022, respectively. There would also be a disposal of 25 mL of alteplase after 24 hours of opening the vial, representing a waste ranging from US$ 188.25 to US$ 216.10. With unit dose preparation, these same 25 mL could be stored for up to 30 days to meet any demands during this period.

If this same number of patients were treated on different days of the month, one patient per day, the daily consumption considering the average dose used for each patient would be 25 mL, which could be accommodated with one 50 mg vial. Seven vials would then be consumed, at a monthly cost that could vary between US$ 2,635.57 and US$ 3,025.33, using the minimum and maximum prices observed between 2020 and 2022, respectively.

In this scenario, the waste would vary between US$ 1,317.79 and US$ 1,512.67.

In the scenario with unit dose preparation, maintaining the average number of patients treated and syringes dispensed per month, the monthly consumption would be four vials, at a cost ranging from US$ 1,506.04 to US$ 1,728.76, with no waste.

Thus, it is possible to estimate that the option with the lowest and highest consumption of alteplase vials would be between four and seven vials. This difference could cost the public coffers an amount between US$ 1,129.53 and US$ 1,296.57, which would be sufficient to cover the purchase of three additional vials of alteplase per month, generating the production of up to 30 doses.

Hypothetically, if this savings of three vials were maintained throughout the entire period since the implementation of the unit dose preparation process over the 32 months of service provision, there would be a savings of 96 vials of alteplase. If 36 of these vials were priced in 2020 at US$ 376.51, 36 vials in 2021 at US$ 413.75, and the other 24 vials in 2022 at US$ 432.19, maintaining the proportion shown thus far, the savings could reach US$ 38,821.92.

In a situation where all patients were treated on the same day, an unlikely scenario given the reality of the service, the use of unit doses would still be more advantageous, as any unused quantity on that day could be stored for up to 30 days, provided that the appropriate storage conditions were followed, thus avoiding waste.

Although considered a high-cost medication, the inventory management software used in the hospital, SIS-Materiais, classifies it in the C position of the ABC curve for medications. This position would theoretically be occupied by items of lower added value, but which correspond to up to 50% of the volume of the inventory[12]. This is due to the fact that this system does not consider only medications but also other elements, such as orthoses and prostheses, thereby distorting the actual position of medications on the curve.

Discussion

Based on the analysis of the results obtained, it was found that the unit dose preparation in the presented hospital is new and still needs time to establish the ideal standard, especially concerning data tabulation, which is currently incomplete. Nevertheless, it is possible to identify economic benefits and a reduction in medication wastage.

From the data used to construct this analysis, it is evident that improvements could be implemented in the processes of recording and documenting the quantities manipulated and dispensed, as well as the development of methodologies to provide more information regarding the disposal of unused medications. This would result in greater robustness and reliability of information, avoiding underreporting of the activities performed and enhancing the reliability of the medication traceability chain, thereby ensuring greater safety for the patients treated.

Although there are no specific data addressing the reduction of waste related to the disposal of medications, it was possible to verify a reduction in waste when analyzing the surveys conducted on saline solution.

Regarding the increased access of patients to medications, based on the evaluation of data concerning methylprednisolone, there is evidence of increased access, as well as a reduction in the shortage of the analyzed medication until the normalization of its procurement. This latter data indicates that unit dose preparation can also be flexible and adapt to the specific needs of the hospital, whether for defined periods or for routine use.

Regarding alteplase, the unit dose preparation not only maintains the physicochemical characteristics, ensuring quality and safety, but also promotes a more rational use of this drug and resource savings, as demonstrated in the literature,[11-14] when considering stability criteria, good manipulation practices, and proper documentation of the processes performed.

The results obtained from this research corroborate the information already available, which states that the unit dose preparation of medications is safe and provides resource savings to the locations where it is implemented[13]. Furthermore, according to the literature, this process ensures greater patient safety, lower rates of administration and preparation errors, greater accuracy in measurements, enhanced microbiological safety,[14] and more time available for nursing professionals for bedside care.[15]

The main limitation of this study was the inability to compare the pre- and post-unit dose preparation phases to assess and compare costs and data regarding patient access to the medications in question. Another important limitation was the lack of systematic data recording of the processes and results of unit dose preparation, particularly information related to the distribution, dispensing, and disposal of medications, which hindered the ability to perform calculations with greater accuracy regarding the actual savings to public funds.

The process of storing printed documents results in losses that compromise the traceability of the medication, thereby generating underreporting of distribution, dispensing, and any disposal of medications. Another reason that may have contributed to the information gaps was the increased workload generated by the pandemic, which caused a historic rise in the number of hospitalizations and outpatient visits, not only at this location but across all health establishments in the country.

As a result, it was not possible to accurately account for, month by month, the number of patients treated and the quantity of doses distributed by the Pharmaceutical Technology Laboratory during the analyzed period, necessitating an approximate average based on the records obtained.

These limitations could be addressed in future studies evaluating the implementation of unit dose preparation processes for new medications, encompassing pre-, during, and post-unit dose preparation periods. However, a partnership with the health service team would be necessary to improve the adopted documentation strategies.

Conclusion

It was found that the unit dose preparation of medications, despite being new and having a small list of included medications, already presents significant benefits in cost reduction, generating estimated savings of up to US$ 38,821.92, minimizing waste and shortages of medications in the hospital, and indirectly expanding patient access to them, primarily due to improved inventory control.

The growing trend of unit dose preparation practices is notable and may bring even greater benefits than those already presented. However, this requires a systematization and organization of data records, such as the quantity of drugs discarded even after unit dose preparation, the number of people receiving such medications, how many vials would be used to supply these same patients without unit dose preparation, among other relevant data.

Acknowledgments

We thank pharmacist Eva Ferraz Fontes and all members of the Hospital's Pharmaceutics Laboratory team studied for their contribution, availability of data, and willingness to collaborate with this research.

References

1. **Agência Nacional de Vigilância Sanitária.** Bulário eletrônico: Actilyse [Internet]. [Brasília]; 2022 [citado 23 set 2023] (Brasil). Available from: https://consultas.anvisa.gov.br/#/bulario/q/?numeroRegistro=103670049
2. **Agência Nacional de Vigilância Sanitária.** Resolução da Diretoria Colegiada n° 67 de 08 de outubro de 2007. Dispõe sobre Boas Práticas de Manipulação de Preparações Oficinais e Magistrais para Uso Humano em farmácias. [Internet], 8 out 2007. (Brasil). Available from: https://bvsms.saude.gov.br/bvs/saudelegis/anvisa/2007/rdc0067_08_10_2007.html
3. **American Association of Hospital Pharmacy.** ASHP statement on unit dose drug distribution. Am J Health Syst Pharm [Internet]. 1 ago 1981 [citado 28 set 2022];38(8):1214-8. Available from: https://doi.org/10.1093/ajhp/38.8.1214
4. **Banco Central do Brasil.** [Internet]. Cotações e boletins; [citado 21 jan 2023]. Available from: https://www.bcb.gov.br/estabilidadefinanceira/historicocotacoes
5. **Bauer AL.** Gestão da assistência farmacêutica: aplicação da curva ABC para gestão de medicamentos em uma farmácia hospitalar do sistema único de saúde. [Trabalho de Conclusão de Especialização] [Porto Alegre]: UFRGS; 2015. [citado 23 mar 2022]; 234p. Available from: https://lume.ufrgs.br/bitstream/handle/10183/130151/000974199.pdf?sequence=1&isAllowed=y

6. **Bizagi - Low-Code Automation Leader.** [Internet]. Bizagi process modeler. versão 3.9; 2021 [citado 19 jun 2023]. Available from: https://www.bizagi.com/pt/plataforma/try-modeler
7. **Buarque Machado de Melo K.** Avaliação do grau de conhecimento e satisfação de profissionais de saúde sobre a central de dose unitária de um hospital escola de Pernambuco [Internet]. [Recife]: Faculdade Pernambucana de Saúde; 2019 [citado 23 mar 2022]. Available from: http://tcc.fps.edu.br:80/jspui/handle/fpsrepo/436
8. **Canterle J.** Secretaria de Saúde do Distrito Federal [Internet]. HRT reduz superlotação e aumenta número de pacientes atendidos no Pronto-socorro; 16 out 2019 [citado 21 jan 2023]. Available from: https://www.saude.df.gov.br/web/guest/w/hrt-reduz-superlotacao-e-aumenta-numero-de-pacientes-atendidos-no-pronto--socorro
9. **Conselho Nacional de Saúde.** Resolução nº 510, de 07 de abril de 2016. Dispõe sobre as normas aplicáveis a pesquisas em Ciências Humanas e Sociais, Diário Oficial da República Federativa do Brasil [Internet], 24 maio 2016 [citado 19 jun 2023] (Brasil). Available from: https://conselho.saude.gov.br/resolucoes/2016/Reso510.pdf
10. **de Negri Filho A, Barbosa Z.** O papel dos hospitais nas redes de atenção à saúde: elementos para pensar uma agenda estratégica para o SUS. Consensus [Brasília] [Internet]. 2014 [citado 4 set 2022]:1-8. Available from: https://www.conass.org.br/consensus/wpcontent/uploads/2019/04/Artigo_consensus_11.pdf
11. **Gonçalves MN.** Rastreabilidade de medicamentos na farmácia hospitalar. Pharm Bras [Internet]. 2010 [citado 5 abr 2022];(79). Available from: https://www.cff.org.br/sistemas/geral/revista/pdf/129/pb79_encarte_farmacia_hospitalar.pdf
12. **JARA MC.** Dose unitarization and patient's safety: hospital pharmacy's or drug industry's responsibility?. Rev Bras Farm Hosp Serv Saude [Internet]. 2019 Mar 11 [cited 2023 Sep 28];3(3). Available from: https://www.rbfhss.org.br/sbrafh/article/view/132
13. **Marin ML.** Modelagem e implantação de sistema de informações para monitorar custo de produção dos produtos fabricados pela Farmácia Hospitalar do Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo [Internet]. [Tese]: Universidade de São Paulo; 2004. 234p [citado 23 set 2023]. Available from: http://www.teses.usp.br/teses/disponiveis/9/9139/tde-22032010-162849/
14. **Silva Souza ÁP et al.** Estudo de viabilidade do sistema de distribuição de medicamentos por dose unitária (SDMDU). Editora Atena [E-book on the Internet]. 4 mar 2020 [citado 23 mar 2022]:1-83. Available from: https://doi.org/10.22533/at.ed.308200405
15. **Sweetman SC et al.** Martindale: the complete drug reference [Internet]. 36a ed. [Reino Unido]: RPS Publishins; 2009. [citado 23 mar 2022]; p. 3694. Available from: https://vnras.com/wp-content/uploads/2018/04/Martindale--The-Complete-Drug-Reference_-36th-Edition.pdf