Revista Brasileira de Enfermagem REBEn

ORIGINAL ARTICLE

Predictive model of hospitalization for children and adolescents with chronic disease

Modelo preditor de internação hospitalar para crianças e adolescentes com doença crônica

Modelo predictor de internación hospitalaria para niños y adolescentes con enfermedades crónicas

Yana Balduíno de Araújo[I]
ORCID: 0000-0002-6308-0904

Sérgio Ribeiro dos Santos[I]
ORCID:0000-0002-7835-3151

Nívea Trindade de Araújo Tiburtino Neves[I]
ORCID: 0000-0001-7874-9546

Érika Leite da Silva Cardoso[I]
ORCID: 0000-0001-7576-1013

João Agnaldo Nascimento[I]
ORCID: 0000-0002-7314-4844

[I] *Universidade Federal da Paraíba. João Pessoa, Paraíba, Brazil.*

How to cite this article:
Araújo YB, Santos, SR, Neves NTAT, Cardoso ELS, Nascimento JA. Predictive model of hospitalization for children and adolescents with chronic disease. Rev Bras Enferm. 2020;73(2):e20180467. doi: http://dx.doi.org/10.1590/0034-7167-2018-0467

Corresponding Author:
Yana Balduíno de Araújo
E-mail:yanabalduino@yahoo.com.br

Submission: 07-11-2018 **Approval:** 10-30-2018

ABSTRACT

Objectives: Describe a predictive model of hospitalization frequency for children and adolescents with chronic disease. **Methods:** A decision tree-based model was built using a database of 141 children and adolescents with chronic disease admitted to a federal public hospital; 18 variables were included and the frequency of hospitalization was defined as the outcome. **Results:** The decision tree obtained in this study could properly classify 80.85% of the participants. Model reading provided an understanding that situations of greater vulnerability such as unemployment, low income, and limited or lack of family involvement in care were predictors of a higher frequency of hospitalization. **Conclusions:** The model suggests that nursing professionals should adopt prevention actions for modifiable factors and authorities should make investments in health promotion for non-modifiable factors. It also enhances the debate about differentiated care to these patients.

Descriptors: Decision Trees; Chronic Disease; Hospitalization; Child; Adolescent.

RESUMO

Objetivos: Descrever um modelo preditor de frequência de internação hospitalar para crianças e adolescentes com doença crônica. **Métodos:** Foi construído um modelo baseado em árvore de decisão, a partir do banco de dados de 141 crianças e adolescentes, com doença crônica, internados em um hospital público federal. Para construção do modelo, foram incluídas 18 variáveis e a frequência de internação foi definida como desfecho. **Resultados:** Obteve-se uma árvore de decisão capaz de classificar corretamente 80,85% dos participantes. A leitura do modelo proporcionou o entendimento de que as situações de maior vulnerabilidade, como desemprego, baixa renda, restrições e ausência de envolvimento da família no cuidado, foram preditoras da maior frequência de internação hospitalar. **Conclusões:** O modelo sugere à enfermagem e equipe ações de prevenção para os fatores modificáveis e investimentos em promoção à saúde para os fatores não modificáveis e fortalece o debate sobre o cuidado diferenciado para esse público.

Descritores: **Á**rvores de Decisões; Doença Crônica; Hospitalização; Criança; Adolescente.

RESUMEN

Objetivos: Describir un modelo predictor de frecuencia de internación hospitalaria para niños y adolescentes con enfermedades crónicas. **Métodos:** Se construyó un modelo basado en árboles de decisión, utilizando un banco de datos de 141 niños y adolescentes con enfermedades crónicas internados en hospital público federal. Para elaborar el modelo fueron consideradas 18 variables, la frecuencia de internación fue definida como desenlace. **Resultados:** Se obtuvo un árbol de decisiones capaz de clasificar correctamente al 80,85% de los participantes. La lectura del modelo permitió entender que las situaciones de mayor vulnerabilidad, como desempleo, bajos ingresos, restricciones y ausencia de compromiso familiar para el cuidado, actuaron como predictoras de mayor frecuencia de internación hospitalaria. **Conclusiones:** El modelo sugiere a la enfermería y equipo acciones preventivas para aquellos factores modificables, e inversión en promoción de salud para los factores no modificables; fortaleciendo también el debate sobre el cuidado diferenciado para esta población.

Descriptores: Árboles de Decisión; Enfermedad Crónica; Hospitalización; Niño; Adolescente.

INTRODUCTION

Providing care to children and adolescents with chronic disease is a challenging process as it involves the pathophysiological severity of the disease, how family members handle the situation, access to services of the health care network, among other factors. Also, influences related to the environment, culture, social and economic condition of the child/adolescent and their families should be considered in this care process.

Several events, particularly hospitalization, change the routine of children/adolescents with chronic disease and their families. This is a complex and significant situation, as the high frequency and duration of hospitalization causes higher costs to the health system and other implications, such as school absence[1-2], difficult social interaction (distance from friends, family members, and school), dietary limitations, physical restrictions (inability to run, play, and practice sports), and financial issues, which may lead to changes in plans and dreams[2-4], and cause problems in adult life[5].

Health care provided to these patients should be specific, organized in networks that provide actions and services to fulfill their needs. However, the existence of these services from care networks constitutes possibilities, but only an articulation between the services and organization of care provision with common purposes, such as compliance with principles of the Unified Health System (SUS) and care organization based on patient needs, can ensure networks of care[6] and access of these patients aiming to reduce hospital admissions.

The opportunity to assist children/adolescents and their families during hospitalization brings to nursing the responsibility of guiding care based on the needs of patients and families, using tools to support this process, thus contributing directly to proper disease management and reduction in length of hospital stay.

In this perspective, using predictive statistical techniques and models can help provide the nursing team and other health professionals involved with a better understanding of the factors that influence hospitalization aiming to reduce hospitalization frequency. Therefore, the care process can have a focus on other points of the care network, that is, primary care and specialized care, and then contribute directly to improving the quality of life of those involved and strengthening the care network.

One of the predictive statistical models most frequently used in health is a decision tree; its main advantages include easy data interpretation and fast generation of results. A decision tree is a reliable technique for developing predictive models and creating classification rules. It is a hierarchical structure method, easy to understand and use, that extracts knowledge from a database and segments heterogeneous data according to similarity, so that they become homogeneous in relation to the study variable[7-8].

Using decision trees in health care has been used in studies in different perspectives, for instance, as a model to help health care professionals identify behavioral patterns of people living with HIV/AIDS while using the Family Health Strategy (FHS) services[9], identify the main factors that influence the evaluation of the dental services offered to pediatric oncology patients, and provide a supporting decision tool that improves the quality of care[10] and the identification of patients not adhering to the antihypertensive treatment[11]. Given the above, the question is: What factors are associated with the frequency of hospitalization of children and adolescents with chronic disease? Identifying the factors involved in this issue may help nursing professionals and the multidisciplinary team develop specific strategies to reduce the frequency of hospitalization by preventing or controlling situations leading to hospitalization.

OBJECTIVES

Describe a predictive model of hospitalization frequency for children and adolescents with chronic disease.

METHODS

Ethical aspects

This study was approved by the Research Ethics Committee of the Federal University of Paraíba and complied with the ethical requirements of Resolution 466/2012[12]. The informed consent form signed by the participants was respected, so participants were allowed to withdraw from the study any moment during the study. Besides the consent form signed by caregivers of the children/adolescents with chronic disease, consent was also obtained from the children/adolescents. The interviews were conducted in nurse offices of three hospitals that provide care to these patients at the moment of admission.

Study design, site, and period

This is an observational cross-sectional study that analyzed data from a database[13] created for the decision model, whose outcome variable was hospitalization frequency. The study was conducted in three hospital services that provide care to children and adolescents diagnosed with a chronic disease in the city of João Pessoa-PB from August 2015 to July 2016.

Study population, sample, inclusion and exclusion criteria

The study population comprised caregivers of children and adolescents diagnosed with a chronic disease. Inclusion criteria were: be the main caregiver of a child or adolescent diagnosed with a chronic disease for at least 2 months; accompany the child or adolescent at hospital admission during data collection for this study. For data collection, the caregiver agreed to participate in the study and signed an informed consent form. Exclusion criteria were: children and adolescents accompanied by parents, caregivers or guardians who did not have sufficient information about their health condition and chronic disease.

The original database[13] contained data from 181 children and adolescents; 38 of those patients were in outpatient consultations and 2 had been hospitalized since birth. In both situations, the outcome variable was not obtained so these 40 subjects were excluded from the sample, which then included 141 cases.

Data collection and organization

For data collection and subsequent construction of the database, an interview was conducted using a validated instrument[13] consisting of 5 categories: Identification of the child/adolescent and main caregiver, Social and health information, Disease and treatment information, Service network, and Family dynamics.

Statistical data analysis

For the analysis and construction of the predictive decision tree model, all variables of the database were tested and compared to the outcome: frequency of hospitalization (admission up to 2 times a year, admission 3 times or more). The variables that met at least one of the following three criteria were selected for model construction: obtain the best results in the correlation chi-square test, present the best distribution in the studied sample, or be relevant to the context of hospitalization experienced by the children/adolescents and their families, considering the clinical practice of nursing, the relevant literature, and the experience of the researchers.

The chi-square test showed a strong association between race (white, non-white) and p=0.047 belonging to Category 1. Treatment of ingested water (treated, untreated) and p=0.040, number of residents (up to 3 residents, 4 residents, 5 or more) and p=0.002, pets (yes, no) and p=0.039 belonging to Category 2. These, in turn, were included in the database for tree model construction.

Based on the criteria of better distribution in the studied sample and relevance to the context of hospitalization, the following variables were selected: Category 1- identification of the child/adolescent and the main caregiver: disability (yes, no), caregiver's education (illiterate, completed elementary education, completed high school, or more), caregiver's employment situation (employed, unemployed, dependent, or retired). Category 2- social and health information: family enrolled in social programs (yes, no), family income (less than one minimum wage, one to two minimum wages, more than two minimum wages). Category 3- disease and treatment information: disease stage (early, chronic, healed/rehabilitation), drug treatment (yes, no), second disease diagnosis (yes, no), restrictions due to diagnosis (yes, no), dependent on complex care (yes, no). Category 4- network of services: uses a basic health unit (UBS) (yes, no, there is none), uses a specialized clinic (yes, no, there is none). Category 5- family dynamics: family involvement in care (yes, no), family receives support (yes, no).

Then, all 18 variables were inserted in a file for the construction of the decision tree-based model using Waikato Environment for Knowledge Analysis (WEKA) version 3.8, then classification rules were developed – and are illustrated below in the 'Results' section. The decision tree structure has nodes that represent the variables of a given problem and leaves that represent the possible responses for these variables, requiring the existence of a target variable or outcome[14-15].

Tree reading or analysis is represented by the classification rules, which can be obtained by identifying the variables (nodes) that lead to the outcome (variable of terminal node). This flow represents a homogeneous subset of variables that are associated with the outcome. In general, tree model rules are constructed using conditionals IF and THEN, and the variables that are included in the tree during computer processing are based on probabilities, inputs, and entropy. At the end of the process, the variables included are considered predictors of the outcome, and a confusion matrix is identified, which measures the method quality (errors and correct answers).

Decision trees can be constructed with algorithms such as J48 decision tree, which is an implementation of open-source C 4.5 algorithm and may involve qualitative, continuous and discrete variables, as well as variables with categorical values and missing values, not requiring a specific probability distribution, considered easy to use and providing the best quality measurement. It is implemented by free software WEKA version 3.8[16-17].

RESULTS

Of all children and adolescents participating in the study (n=141), 77 (54.6%) were male and 64 (45.4%) were female, 48 (34%) aged 0-2 years, 21 (15%) aged 3-5 years, 42 (29%) aged 6-12 years, and 31 (22%) aged 13-18 years. Regarding race/skin color, 52 (36.8%) were white, 9 (6.4%) were black, 78 (53.3%) were brown, 2 (1.4%) were indigenous. Regarding family income, 31 (21.9%) reported up to 1 minimum wage, 85 (60.2%) reported 2-4 minimum wages, and 25 (17.7%) reported 5 or more minimum wages.

Among the 18 variables selected for the decision tree construction, 12 comprised the model: race/skin color, number of residents, pets, disability, caregiver's employment situation, family enrolled in social programs, family income, disease stage, second disease, restrictions due to diagnosis, dependent on complex care, and family involvement in care.

The model was able to classify 114 individuals, presenting 80.85% of correct answers, according to the classification matrix in Table 1, which details the correct answers and errors of the model. The correct answers of the model are in the main diagonal of the matrix and the errors are out of it. As the purpose of this model is the identification of predictive variables of hospitalization frequency (admission up to 2 times a year, admission 3 times or more), the results showed this model was efficient for this purpose.

The classification percentage of 80.85% was obtained by dividing the total number of correct answers (114) by the total classifications (141). Reading the classification matrix shows that, among the 84 cases that presented hospitalization frequency of up to 2 times a year, the model was able to correctly classify 75 cases and, among the 57 cases presenting hospitalization frequency of 3 times or more, 39 were correctly classified. After the result obtained by WEKA, the decision tree was obtained, which is illustrated in Figure 1.

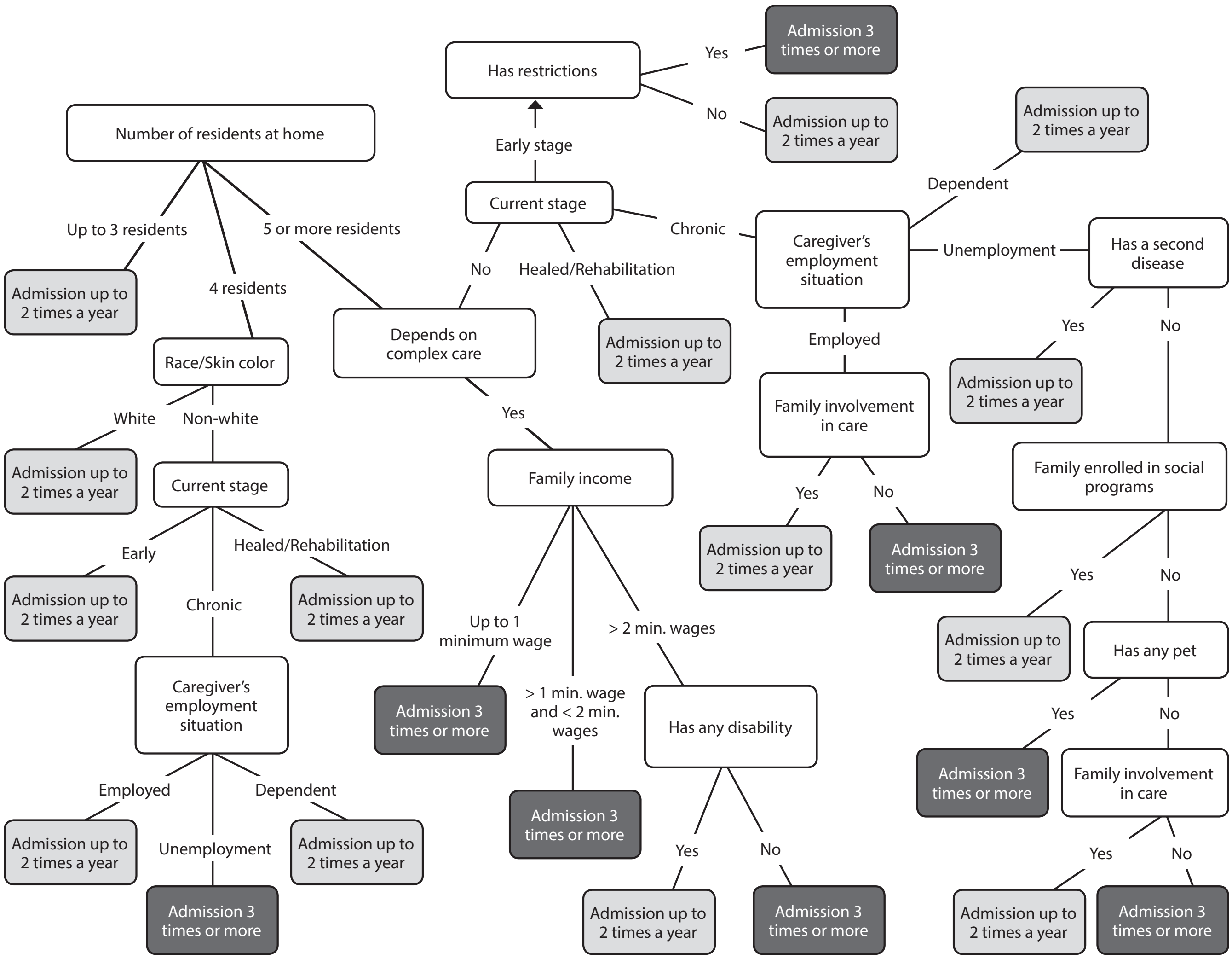
Reading the model allowed to extract 36 decision rules (Chart 1). The classification rules obtained in the statistical model confirm the importance of the decision variables in the outcome of hospitalization frequency. The variables closest to the tree root have greater weight on the separation between the groups that are admitted more or less frequently.

The tree model allowed the identification of the variables leading to the study outcome.

Table 1 - Decision tree-based matrix classification, João Pessoa, Paraíba, Brazil, 2018

A	B
75	9
18	39

Note: a=admission up to 2 times a year; b=admission 3 times or more.



Source: Adapted from WEKA, 2018.

Figure 1 - Decision tree to identify predictive variables of hospitalization frequency among children and adolescents with chronic disease, João Pessoa, Paraíba, Brazil, 2018

Chart 1 – Decision rules developed from the decision tree: the variable is the necessary condition (IF), and the decision (THEN) is the result obtained from the decision variable, João Pessoa, Paraíba, Brazil, 2018

Decision rules	
Variable	**Decision**
1. IF the number of residents in one home is up to 3 residents.	THEN admission occurs up to 2 times a year.
2. IF the number of residents is 4.	THEN race/skin color should be considered.
3. IF the number of residents is 4 and the race/skin color is white.	THEN admission occurs up to 2 times a year.
4. IF the number of residents is 4 and the race/skin color is non-white.	THEN the current disease stage should be considered.
5. IF the number of residents is 4 and the race/skin color is non-white and the disease is in its early stage.	THEN admission occurs up to 2 times a year.
6. IF the number of residents is 4 and the race/skin color is non-white and the disease is in its healed/rehabilitation stage.	THEN admission occurs up to 2 times a year.
7. IF the number of residents is 4 and the race/skin color is non-white and the disease is in its chronic stage.	THEN the caregiver's employment situation should be considered.
8. IF the number of residents is 4 and the race/skin color is non-white and the disease is in its chronic stage and the caregiver is employed.	THEN admission occurs up to 2 times a year.

To be continued

Chart 1

Decision rules	
Variable	**Decision**
9. IF the number of residents is 4 and the race/skin color is non-white and the disease is in its chronic stage and the caregiver is unemployed.	THEN admission occurs 3 times a year or more.
10. IF the number of residents is 4 and the race/skin color is non-white and the disease is in its chronic stage and the caregiver is dependent.	THEN admission occurs up to 2 times a year.
11. IF the number of residents is 5 or more.	THEN dependency on complex care should be considered.
12. IF the number of residents is 5 or more and one is dependent on complex care.	THEN family income should be considered.
13. IF the number of residents is 5 or more and one is dependent on complex care, and the family income is up to one minimum wage.	THEN admission occurs 3 times a year or more.
14. IF the number of residents is 5 or more and one is dependent on complex care, and the family income is over one minimum wage and less than two minimum wages.	THEN admission occurs 3 times a year or more.
15. IF the number of residents is 5 or more and one is dependent on complex care, and the family income is over two minimum wages.	THEN the existence of disability should be considered.
16. IF the number of residents is 5 or more and one is dependent on complex care, and the family income is over two minimum wages and one has a disability.	THEN admission occurs up to 2 times a year.
17. IF the number of residents is 5 or more and one is dependent on complex care, and the family income is over two minimum wages and there is no disability.	THEN admission occurs 3 times a year or more.
18. IF the number of residents is 5 or more and there is no dependency on complex care.	THEN the current disease stage should be considered.
19. IF the number of residents is 5 or more and there is no dependency on complex care and the disease is in its healed/rehabilitation stage.	THEN admission occurs up to 2 times a year.
20. IF the number of residents is 5 or more and there is no dependency on complex care and the disease is in its early stage.	THEN any disease-related restriction should be considered.
21. IF the number of residents is 5 or more and there is no dependency on complex care and the disease is in its early stage and there is a disease-related restriction.	THEN admission occurs 3 times a year or more.
22. IF the number of residents is 5 or more and there is no dependency on complex care and the disease is in its early stage and there is no disease-related restriction.	THEN admission occurs up to 2 times a year.
23. IF the number of residents is 5 or more and there is no dependency on complex care and the disease is in its chronic stage.	THEN the caregiver's employment situation should be considered.
24. IF the number of residents is 5 or more and there is no dependency on complex care and the disease is in its chronic stage and the caregiver is dependent.	THEN admission occurs up to 2 times a year.
25. IF the number of residents is 5 or more and there is no dependency on complex care and the disease is in its chronic stage and the caregiver is employed.	THEN family involvement in care should be considered.
26. IF the number of residents is 5 or more and there is no dependency on complex care and the disease is in its chronic stage and the caregiver is employed and the family is involved in care.	THEN admission occurs up to 2 times a year.
27. IF the number of residents is 5 or more and there is no dependency on complex care and the disease is in its chronic stage and the caregiver is employed and the family is not involved in care.	THEN admission occurs 3 times a year or more.
28. IF the number of residents is 5 or more and there is no dependency on complex care and the disease is in its chronic stage and the caregiver is unemployed.	THEN a second disease diagnosis should be considered.
29. IF the number of residents is 5 or more and there is no dependency on complex care and the disease is in its chronic stage and the caregiver is unemployed and there is a second disease diagnosis.	THEN admission occurs up to 2 times a year.

To be continued

Chart 1 (concluded)

Decision rules	
Variable	**Decision**
30. IF the number of residents is 5 or more and there is no dependency on complex care and the disease is in its chronic stage and the caregiver is unemployed and there is not a second disease diagnosis.	THEN family enrollment in social programs should be considered.
31. IF the number of residents is 5 or more and there is no dependency on complex care and the disease is in its chronic stage and the caregiver is unemployed and there is not a second disease diagnosis and the family is enrolled in social programs.	THEN admission occurs up to 2 times a year.
32. IF the number of residents is 5 or more and there is no dependency on complex care and the disease is in its chronic stage and the caregiver is unemployed and there is not a second disease diagnosis and the family is not enrolled in social programs.	THEN family pets should be considered.
33. IF the number of residents is 5 or more and there is no dependency on complex care and the disease is in its chronic stage and the caregiver is unemployed and there is not a second disease diagnosis and the family is not enrolled in social programs and has pets.	THEN admission occurs 3 times a year or more.
34. IF the number of residents is 5 or more and there is no dependency on complex care and the disease is in its chronic stage and the caregiver is unemployed and there is not a second disease diagnosis and the family is not enrolled in social programs and has no pets.	THEN family involvement in care should be considered.
35. IF the number of residents is 5 or more and there is no dependency on complex care and the disease is in its chronic stage and the caregiver is unemployed and there is not a second disease diagnosis and the family is not enrolled in social programs and has no pets and the family is involved in care.	THEN admission occurs up to 2 times a year.
36. IF the number of residents is 5 or more and there is no dependency on complex care and the disease is in its chronic stage and the caregiver is unemployed and there is not a second disease diagnosis and the family is not enrolled in social programs and has no pets and the family is not involved in care.	THEN admission occurs 3 times a year or more.

Source: Developed from WEKA data, 2018.

DISCUSSION

Among the variables from the database, the number of residents, the decisive variable of the root node, highlights the discussion about the economic, social and housing conditions of these children/adolescents and their families. A smaller number of residents was a predictor of lower hospitalization frequency (up to 2 times a year). An intermediate situation (4 residents) was conditioned to other attributes: the course of the disease (current stage), social and economic conditions (employment situation), and racial aspects (race/skin color). The worst outcome was obtained due to the caregiver's unemployment situation. Finally, in the last situation, home with five or more residents, many internal nodes and branches are observed towards the worst outcome (three or more admissions per year).

Reading the model provides an understanding that situations of greater vulnerability, such as unemployment, low income, restrictions, and lack of family involvement, were predictors of higher frequency of hospitalization. Variables related to having a disability and a second disease diagnosis did not present this pattern. Based on the findings of this study, it can be assumed that in cases with a disability, there is also another service available in the network to provide care, and probably this is why these children and adolescents are hospitalized less frequently. In the case with a second disease diagnosis, no justification could be obtained based on the results.

In this sense, the focus of interventions and decision making by the nursing and health staff, considering the model, can be subdivided into two possibilities: prevention for modifiable factors and investments in health promotion for non-modifiable factors. In this conception, variables of income, employment situation, enrollment in social programs, pets, and family involvement in care were considered modifiable, particularly due to nursing interventions related to care to this population. Variables of race/skin color, complex care, second disease, disability, restrictions, and disease stage were considered non-modifiable, but with chances for interventions in the perspective of health promotion. Despite this division made only for the purpose of facilitating the interpretation of the model, the variables are interconnected and conditioned to each other, showing the complexity involved in hospitalization and the imperative to consider the whole context experienced by everyone involved.

In the context of the disease, an increase in family expenses is often aggravated by the caregiver's lost job due to frequent visits and hospitalization or exclusive dedication to care and treatment of the child/adolescent[18]. Therefore, it is unusual to find caregivers (mothers) of children/adolescents with chronic diseases in the labor market[18-19]. This reality causes changes in the family dynamics due to reduced budget[20], which may increase stress levels in family relationships. In order to support themselves, they have the financial support of the benefit of illness allowance or another program such as family allowance (Bolsa Família), which becomes basically the only source of income to cover the treatment and family expenses[20-21].

In the model, the course of the disease in the chronic stage associated with the caregiver's unemployment provided the outcome of higher frequency of hospitalizations. Considering that this factor directly influences the social and economic condition of the family and the access to services, with a direct impact on coping with chronic disease, an articulation of the social care network and inclusion of these families in social programs are required to ensure short-term family support and possibly improve access to services. However, medium- and long-term strategies should be planned to help families generate income by providing training and inclusion in the labor market to family members who have a profession, and encouraging professionalization of those who do not have such training.

A relationship between having a pet and aggravation of chronic disease was observed for asthma[22]; however, this variable contributed to the worst outcome and should be further investigated regarding its influence in other chronic diseases. Another study[23] highlighted this variable is among the factors that influence the social determination of the disease among children. Then, during the care process, nurses should seek more information related to the home environment and its general conditions in order to discourage having pets in cases of aggravation. Family involvement in care involves several complex, subjective and circumstantial factors, and, in general, this involvement may undergo changes along the course of the disease[24]. In this study, less family involvement was a predictor of higher frequency of hospitalization. Therefore, the nursing team should seek more information about the family context to promote more comprehensive and extended care for the children/adolescents and their families.

In a broader perspective, the authors point out that the relationship between race/skin color and chronic diseases should not be understood from the biological point of view, but as a social variable that carries the burden of historical and cultural constructions, which aggravates socioeconomic inequalities and the lack of health equity among racial groups[25]. Given the influence of social inequalities, both as conditions and determinants of the health disease process, this reality has to change and ensure conditions for these families to have better access to health services, education, employment and income generation through feasible strategies in each case. Then, considering the central role of nursing professionals in care, their involvement and commitment are very important in providing access and, above all, the required visibility to cause reflections and changes, in order to adapt care offered to this population, fulfill their health needs, and strengthen the discussion about the formulation of public policies for the concerned population.

In complex care management, another issue emerges, as the actions and services available (UBS, Home Care Service, among others) often do not guarantee the provision or support for care and, in many cases, the maintenance of gastrostomies, tracheostomies, bladder tubes, among other complex procedures are under the responsibility of the caregiver, who is not always instructed to perform it[26]. Therefore, providing such care at home requires adjustments to the daily routine due to technical procedures that have to be performed, such as bladder catheterization, continuous drug delivery, prevention of skin injury, and use of orthosis[27]. In this process, hospitalization is the solution for proper care provision. Then, an articulation between the care network and continuous training of those involved in the problem is critical to avoid hospitalization.

In the course of the disease, the early stage associated with restrictions was also related to a higher frequency of hospitalization. A study[28] describes that dealing with the restrictions caused by the disease requires continuous care and instructions, so that both the child and the family can adapt gradually and properly to the new routine imposed by the disease.

Chronic diseases need multiprofessional and interdisciplinary monitoring articulated with care networks to promote continuous, integral and longitudinal care, so the best possible quality of life can be extended to the adult life of these children and adolescents. Then, the professionals involved have to consider the level of understanding of the children, adolescents and their families and make decisions to establish proper communication and guide them about the disease, its implications and especially about care and restrictions, thus contributing to disease handling, therapy adherence, and improved quality of life of the family, rescuing the family autonomy and including it as a target of this care process. The event of hospitalization, although painful and limiting, should be seen as an opportunity to promote and develop health education for and with these families.

Nursing interventions should be individualized and agreed with the care network, as it is not always possible to predict which service the family will seek. Considering that most families of this study live in areas covered by a UBS, it is important to highlight the responsibility and importance of nursing professionals and their position in the care network, providing through their attributes of bond, proximity and longitudinality a communication routine to monitor the course of the disease in the family and other demands involved.

The support of health information and education regarding food, therapy, restrictions and recommendations should be discussed with the family members, and have their feedback, to ensure such information has been absorbed. This attitude is a possible intervention for nursing professionals, but it should also be incorporated by other professionals who are part of the network, so that each contact with the family ensures process continuity, resolution of questions, and stronger connection.

However, providing information and contributing to the construction of knowledge for and with these families do not guarantee changes in their behavior. This situation is aggravated when the feeling of insecurity and the socioeconomic reality of poverty do not allow them to fulfill their plans and responsibilities[29]. Then, interventions that contribute to reducing these social inequalities are imperative, especially regarding the predictive variables of higher frequency of hospitalization, which are considered as modifiable factors.

Limitations of the Study

The results of the study, when applied to general populations, may have limitations due to sample representativeness, specifically referring to children and adolescents with chronic disease.

Contributions to nursing, health or public policy

Statistical models as tools that support the decision-making process directly influence the impact of actions developed mainly when such models are based on the reality of the assisted population. Nursing, as it plays a central role in care, can use this model to qualify its practice and offer differentiated care to the population in question, and promote discussions about the need to formulate specific public policies for children and adolescents with chronic diseases.

CONCLUSIONS

The description of a predictive model of hospitalization frequency for children and adolescents with chronic disease may contribute directly to the qualification and adequacy of nursing care to this population. As professionals who perform horizontal actions and services in all areas of the health care network, nurses can qualify their care actions based on models that bring more information about the target population.

The study about the variables that are directly associated with a higher frequency of hospitalization suggests strategies that, when implemented in concrete actions, offer the potential to change the reality of these children, adolescents and their families. Those involved in the process, such as family members, health professionals of local team, specialized services (outpatient services, clinics and hospitals), different sectors of civil society (education, security, job and income generation), and the community should act in order to strengthen and improve it, contributing to lower frequency of hospitalization.

FUNDING

This study was funded by CNPq through Edital Universal 01/2014, process no. 448716/2014-03.

REFERENCES

1. Xavier TGM, Araújo YB, Reichert APS, Collet N. Classe Hospitalar: produção do conhecimento em saúde e educação. Rev Bras Educ Esp [Internet]. 2013 [cited 2018 Feb 12];19(4):611-22. Available from: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1413-65382013000400010&lng=en&nrm=iso&tlng=pt
2. Costa TS, Morais AC. Child hospitalization: child living from graphical representations. J Nurs UFPE On Line. 2017;11(Supl. 1):358-67. doi: 10.5205/reuol.7995-69931-4-SM.1101sup201715
3. Caires S, Esteves CH, Correia S, Almeida I. Palhaços de hospital como estratégia de amenização da experiência de hospitalização infantil. Psico-USF. 2014;19(3):377-86. doi: 10.1590/1413-82712014019003001
4. Gomes GC, Erdmann AL, Oliveira PK, Xavier DM, Santos SSC, Farias DHR. The family living the time during the hospitalization of the child: contributions for nursing. Esc Anna Nery Rev Enferm. 2014;18(2):234-40. doi: 10.5935/1414-8145.20140034
5. Viero V, Beck CLC, Freitas PH, Coelho APF, Lima SBS, Machado BP. Enfrentamentos da criança com câncer frente ao afastamento escolar devido internação hospitalar. Rev Enferm UFSM. 2014;4(2):368-77. doi: 10.5902/2179769210956
6. Nóbrega VM, Silva MEA, Fernandes LTB, Viera CS, Reichert APS, Collet N. Chronic disease in childhood and adolescence: continuity of care in the Health Care Network. Rev Esc Enferm USP. 2017;51:e03226. doi: 10.1590/s1980-220x2016042503226
7. Cervantes J, Lamont FG, López-Chau A, Mazahua LR, Ruíz JS. Data selection based on decision tree for SVM classification on large data sets. Appl Soft Comp. 2015;37:787-98. doi: 10.1016/j.asoc.2015.08.048
8. Ramya MC, Lokesh V, Manjunath TN, Hegadi RS. A Predictive model construction for mulberry crop productivity. Proc Comp Science. 2015;45:156-65. doi: 10.1016/j.procs.2015.03.108
9. Medeiros LB, Trigueiro DRSG, Silva DM, Nascimento JA, Monroe AA, Nogueira JA, et al. Integration of health services in the care of people living with aids: an approach using a decision tree. Ciênc Saúde Colet. 2016;21(2):543-52. doi: 10.1590/1413-81232015212.06102015
10. Carneiro TV, Protásio APL, Valença AMG, Moraes RMM. Avaliação mediante árvore de decisão da qualidade do atendimento de pacientes oncológicos pediátricos. Rev Baiana Saúde Pública. 2014;38(4):882-96. doi: 10.22278/2318-2660.2014.v38.n4.a723
11. Medeiros ARC, Araújo YB, Vianna RPT, Moraes RM. Modelo de suporte à decisão aplicado à identificação de indivíduos não aderentes ao tratamento anti-hipertensivo. Saúde Debate. 2014;38(100):104-18. doi: 10.5935/0103-104.20140016
12. Ministério da Saúde (BR). Resolução nº 466, de 12 de dezembro de 2012. Aprova diretrizes e normas regulamentadoras de pesquisas envolvendo seres humanos [Internet]. Brasília: Ministério da Saúde; 2012 [cited 2018 Feb 12]. Available from: https://bvsms.saude.gov.br/bvs/saudelegis/cns/2013/res0466_12_12_2012.html.
13. Araújo YB. Sistema de Informação de Crianças e Adolescentes com Doença Crônica (SICADC): uma ferramenta de apoio à decisão [tese] [Internet]. João Pessoa: Universidade Federal da Paraíba; 2017 [cited 2018 Feb 12]. Available from: https://sig-arq.ufpb.br/arquivos/20171880885bd5473637d5d086e8753c/TESE_YANA_BAUDUINO_DE_ARAUJO.pdf
14. Last M, Tosas O, Cassarino TG, Kozlakidis Z, Edgeworth J. Evolving classification of intensive care patients from event data. Artif Intell Med. 2016;69:22-32. doi: 10.1016/j.artmed.2016.04.001
15. Larose DT, Larose, CD. Data mining and predictive analytics. 2nd ed. USA: Wiley & Sons; 2015.
16. Bhargava N, Bhargava R, Mathuria M. Decision tree analysis on j48 algorithm for data mining. Int Journ Adv Research in Comp Scie Soft Eng. 2013;3(6):1114-9.

17. Chauhan H, Chauhan A. Implementation of decision tree using C4.5 algorithm in decision making of loan application by debtor (Case study: Bank pasar of Yogyakarta Special Region). In.: 2015 3rd International Conference on Information and Communication Technology (ICoICT), 2015 May 27-29. 2013;3(10):1-3. doi: 10.1109/ICoICT.2015.7231400
18. Alves SP, Bueno D. O perfil dos cuidadores de pacientes pediátricos com fibrose cística. Ciênc Saúde Colet. 2018;23(5):1451-7. doi: 10.1590/1413-81232018235.18222016
19. Lima MF, Arruda GO, Vicente JB, Marcon SS, Higarashi IH. Crianças dependentes de tecnologia: desvelando a realidade do cuidador familiar. Rev Rene [Internet] 2013 [cited 2018 Oct 10];14(4):665-73. Available from: http://periodicos.ufc.br/rene/article/view/3515/2757
20. Silva MEA, Gomes IP, Machado NA, Vaz EMC, Reichert APSML, Collet N. Implications of chronic condition of the child for its family. Rev Ciênc Cuid Saúde. 2014;13(4):697-704. doi: 10.4025/cienccuidsaude.v13i4.20816
21. Vargas RM, Martins DM, Scheerena MC, Brazunaa JM, Spigolona MFM, Maldonado MJM, et al. Resiliência familiar no contexto da encefalopatia crônica infantil. Rev Ensaios Ciênc, Ciênc. Biol. Agrar. Saúde. 2014;18(3):131-5.
22. Nascimento ES, Porto E, Brandão GCG. Risk factors associated with respiratory diseases in children. J Nurs UFPE On Line. 2015;9(supl. 6):8679-87. doi: 10.5205/reuol.7061-61015-5-SM0906supl201508
23. Reis RS. A influência dos determinantes sociais na saúde da criança. Libertas [Internet]. 2005 [cited 2018 Feb 20];4,5(esp):17-42. Available from: https://libertas.ufjf.emnuvens.com.br/libertas/article/view/1712/1196
24. Greenley RN, Reed-Cavaleiro B, Blount RL, Wilson HW. Dyadic confirmatory factor analysis of the inflammatory bowel disease family responsibility questionnaire. J Pediatr Psychol. 2013;38(8):871-82. doi: 10.1093/jpepsy/jst030
25. Malta DC, Moura L, Bernal RTI. Diferenciais dos fatores de risco de Doenças Crônicas não Transmissíveis na perspectiva de raça/cor. Ciênc Saúde Colet. 2015;20(3):713-25. doi: 10.1590/1413-81232015203.16182014
26. Lima MF, Arruda GO, Vicente JB, Marcon SS, Higarashi IH. Crianças dependentes de tecnologias: desvelando a realidade do cuidador familiar. Rev Rene [Internet]. 2013 [cited 2018 Feb 26];14(4):665-73. Available from: http://www.periodicos.ufc.br/rene/article/view/3515/2757
27. Salvador MS, Gomes GC, Oliveira PK, Gomes VLO, Busanello J, Xavier DM. Strategies of families in the care of children with chronic diseases. Texto Contexto Enferm. 2015;24(3):662-9. doi: 10.1590/0104-07072015000300014
28. Martins EMCS, Ataíde MBC, Silva DMA, Frota MA. Vivência de mães no cuidado à criança diabética tipo 1. Rev Rene [Internet]. 2013 [cited 2018 Feb 28];14(1):42-9. Available form: http://periodicos.ufc.br/rene/article/view/3323/2561
29. Moreira NCN, Gomes R, Sá MRC. Doenças crônicas em crianças e adolescentes: uma revisão bibliográfica. Ciênc Saúde Colet. 2014;19(7):2083-94. doi: 10.1590/1413-81232014197.20122013