Frequency Weighted Hospitalizations (FWH): a Proposed Indicator to Mitigate Moral Risk in Hospital Management Contracts

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ABSTRACT

In this article, the relationship between the hospital departures indicator, the main indicator for evaluating the performance of hospital management contracts in Bahia, and the incidence of moral hazard in light of Agency Theory was evaluated. Using a qualitative approach based on management contracts and data from the Hospital Admission System (SIH/SUS) in 2019, the performance of three hospitals representing the prevailing management models in the state was compared: direct management, Social Organization (OS), and Public-Private Partnership (PPP). The lower productivity in direct management and the higher frequency of low-complexity hospitalizations in the OS suggest the incidence of moral hazard in service delivery. As a strategy to mitigate this risk, a quantitative indicator is proposed for management contracts, which considers different types of hospitalizations in a weighted manner, based on variables available in the SIH/SUS. Although the inconsistencies in this system limit the specificity and potential of the proposed indicator, it is believed that its use can contribute to improving the evaluation of hospital management contracts and enhancing the SIH/SUS database, enabling further study of hospital admission measurement in future research.

Keywords: Moral hazard, Control, Hospital management contracts, Performance evaluation indicator.

INTRODUCTION

The fiscal crisis that affected the main economies of the capitalist world in the mid-1970s resulted in a broad reform movement in public administration, known as New Public Management[1], which proposed a management model based on controlling results, in which the state would assume the main role of regulator. In Brazil, this reform materialized in the 1995 Master Plan for the Reform of the State Apparatus (PDRAE), which encouraged the transfer of management of state public bodies to non-state public entities, represented by the then-created Alternative Models of Indirect Management (MAGI), among them Social Organizations - OS, and Public-Private Partnerships - PPP, regulated by management contracts, incorporated into the management of public hospitals[2]. This model was part of the National Hospital Care Policy (PNHOSP) and represented an important change in hospital financing.

Until then, hospital providers were paid proportionally to the volume and type of production[3], recorded in the SUS Hospital Information System (SIH/SUS), which identifies a main procedure for each hospitalization, associated with a payment amount previously defined in the SUS Table. This amount should be proportional to the respective costs of the hospitalization, which in practice has not been the case, and is the main criticism of this financing model.

With the new model, service providers are now paid a monthly amount previously defined in the budget, based on the hospital's estimated costs for a level of

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operation and efficiency that corresponds to the maximum use of installed capacity to produce quality admissions. This amount is benchmarked against the costs of public hospitals of the same size. The payment is composed of two components: a fixed part that is independent of production, and a variable part that can be adjusted in varying proportions according to the evaluation of quantitative and qualitative indicators. The variable component serves as an incentive for the provider to meet the goals and objectives set forth in the contract. The advantage of this model, known as a global budget associated with performance evaluation, lies in the predictability of expenditure for the public manager and revenue for the service provider, as well as the incentive for improved performance in achieving the targets of the indicators established in the contract[3].

The quantitative indicator for the hospitalization service in management contracts is "hospital admissions," which corresponds to the frequency of admissions considered without distinction, regardless of differences in the type and duration of treatment, the intensity of resource consumption, or the use of technology. The contractor is entitled to the total variable remuneration if it meets the target number of hospital admissions, irrespective of the complexity or cost of these admissions. This system may incentivize service providers to achieve the target with simpler, lower-cost hospitalizations, as this would require less effort and yield greater profit.

From this perspective, financing hospitals through a global budget associated with performance evaluation may be less advantageous than the previous model, since the indicator used in public hospital management contracts does not effectively differentiate between types of hospitalizations. This could lead to a situation where a certain volume of production is certified, its performance recognized, and a financial incentive paid, all under the uncertainty of whether the presented results genuinely meet the contract's objective of addressing the hospitalization needs of the reference population.

Providing hospital services requires a high level of technical expertise and must be carried out by specialists. The relationships formed when a service is delegated to a specialist are explored in Agency Theory. According to this theory, the person delegating the service, known as the principal, and the specialist, known as the agent, have different interests in the service's execution. The principal seeks maximum efficiency, while the agent aims for minimal effort and maximum profit. As a specialist and executor of the service, the agent possesses privileged information, which can be used to further his objectives at the expense of the principal's goals—this constitutes moral hazard according to the theory.

This study assumes that the inability of the "hospital outputs" indicator to differentiate hospitalizations renders the measurement system in hospital management contracts vulnerable to moral hazard. This vulnerability allows providers to meet targets and receive financial rewards without achieving the efficiency stipulated in the contract. The main objective is to propose a quantitative indicator for public hospital management contracts in Bahia, considering the different types of hospitalizations, based on variables available in the SUS hospital information system. The research question aims to explore how to develop a production measure that mitigates the moral hazard associated with the measu-

rement of hospitalizations in public hospital management contracts in Bahia.

To address this question, we employed Agency Theory in a qualitative approach, comparing the hospitalization measures used in hospital management models in Bahia, and analyzing performance variations using statistical measures applied to the 2019 public database of hospital admissions from SIH/SUS. The specific objectives were: a) to identify the potential for moral hazard related to the hospitalization measures used in these management models, and b) to evaluate the ability of variables in the SUS information system to differentiate hospital admissions. It is important to note that although there are several potential sources of moral hazard in hospital management contracts, this study focused on the moral hazard associated with the measurement of hospitalization. The year 2019 was chosen as the most recent period for consolidated SIH/SUS data, avoiding the atypical data from 2020 caused by the CODIV-19 pandemic's impact on public hospital production.

The proposed new indicator for hospital admissions will improve SESAB's hospital management contracts by allowing for better specification of hospital services and strengthening the link between indicators, goals, and contract objectives, thereby increasing the likelihood of achieving meaningful results for the health system. Enhancing transparency by recognizing the differences in complexity and cost of hospital admissions will help reduce information asymmetry between the parties, making the reward system more efficient and the public-private relationship more transparent. Additionally, by countering the opportunistic practice of prioritizing less complex admissions, this new indicator will appeal to service providers committed to quality and efficiency, as their efforts will be more appropriately rewarded.

The importance of contracts in service provision relationships, as analyzed through the lens of Agency Theory, is outlined below, with a focus on the specificities of the health sector. This is followed by a description of the adopted methodology. Subsequently, the study's results are presented and analyzed, including the potential incidence of moral hazard associated with the "hospital outflows" indicator. Based on these findings, a new indicator for hospitalizations in public hospital management contracts is proposed. The study concludes with final considerations, limitations, and suggestions for future research.

THEORETICAL PATHS

The "agency relationship" is defined as a contractual relationship between two or more parties, in which one of them, the "agent", acts on behalf of the other, called the "principal", in the performance of services that involve some decision-making power[4,5]. It is based on two assumptions: (1) "principal" and "agent" are driven by self-interest towards maximizing their own utility (profit), and the parties often have divergent objectives, (2) the asymmetry of information between principal and agent, related to the latter's specialization, constitutes a challenge to the alignment of objectives between the parties.

The Agency Theory studies the influence of information asymmetry in the agency relationship according to two concepts, organized according to the phase of the relationship in which the problem occurs, recognized as "adverse selection" in the pre-contractual phase and "moral ha-

zard", in the post-contractual phase[6]. In the latter case, which is directly related to the study's research question, one of the parties to the relationship undertakes actions that affect the value of the transaction for the other party, in circumstances in which the second party cannot fully monitor or control, creating a demand for verification of the agent's behavior by the principal, and at the same time, the need to build incentives that make the desired result feasible. The standard of behavior expected of the agent and the result of the operation desired by the principal must be formalized in the contract, which is the unit of analysis of the Agency Theory[7]. These two guiding logics (behavior or outcome) are generally present to some degree in all contracts.

The effectiveness of the outcome--based contract logic in combating agent opportunism is due to the linking of the reward, usually financial, to the outcome expected by the principal, which promotes, to a certain extent, an alignment of interests between principal and agent, stimulating the agent's greater propensity to take risks and reducing conflict. The cost for the agent to take on greater risk will be considered in their decision-making process and varies positively with the degree of uncertainty in the external environment7. The application of Agency Theory in health has specificities that increase the challenge of aligning interests between principal and agent, listed with their respective references in Chart 1.

Chat 1: Main references regarding the specificities of the health sector in service provision relationships

Uncertainty as a determining factor in the relationship between the parties in the provision of health services increases the asymmetry of information and is antagonized by the incorporation of the expectation of trust in the doctor-patient relationship, as a "social institution"[8].
The microeconomic logic of the doctor-patient relationship explains the role of the state in health care, dependent on professional self-regulation. Information technology using statistics partly compensates the information asimmetry[9].
Variability in the cost of health care is influenced by the dual role played by the doctor in service provision[10].
Health systems based on public or private insurance boost the generation of demand from the offer[11].
The health financing model must favor increased efficiency, improved quality and accessibility, allow patient choice of service and be easy to implement[12].
Advantage of using payment for performance, linked to the achievement of quantitative or qualitative targets associated with different financing models[3].
Clinical outcome measures must take into account the different types of patient, the criteria for defining the type of treatment, the type of discharge, sample variations, and the technical backing of the interventions. Length of stay is one of the essential measures in the evaluation of hospitals[13].
Hospital evaluations should consider homogeneous groups of hospitalizations from a technical point of view and in terms of resource consumption. With this in mind, the Diagnostic Related Group (DRG) hospitalization classification system was created and adopted in several countries[14].
Need to take into account the complexities of care that differentiate hospitalizations when evaluating contractualization of Bahia's own hospitals[2].
Studies that use the frequency of hospitalizations as a measure of performance evaluation in public hospitals, considering hospitalizations homogeneously[15,16,17,18,19].

Source: Elaborated by the author.

In the scope of this article, it is understood that the differences in complexity and cost of hospital admissions are an impediment to considering them in a homogeneous way when evaluating hospital results. Using the methodology described below, we are looking for the elements available in the SUS hospital information system that can classify admissions according to their technical similarity and resource consumption, with the greatest possible homogeneity, to be used as a reference for the proposal of a new indicator for hospital management contracts, in order to increase the criticality in the evaluation of these results and limit the scope for moral hazard in the management of public hospitals.

METHODOLOGICAL PROCEDURES

In order to test the inability of the "hospital outputs" indicator to differentiate between admissions, making the management contract vulnerable to moral hazard, a central assumption of the research, the production of three state public hospitals was comparatively evaluated: Hospital Geral Cleriston Andrade (HGCA), under direct management; Hospital Regional de Santo Antônio de Jesus (HRSAJ), managed by OS and Hospital do Subúrbio (HS) managed by PPP. The hospitals investigated were chosen because we wanted to analyze different management models. In this way, it was possible to make comparisons based on categories of hospital productivity and complexity of admissions, using measures of absolute frequency, relative frequency, averages and proportions applied to their production in 2019, testing the assumptions:

Chart 2: Assumptions related to the incidence of moral hazard in hospitalizations

Assumption	Test	Measure
The indicator "hospital exits" associated with the financial incentive contributes to an increase in the service's productivity.	Comparison of productivity between hospitals linked (OS and PPP) and not linked to the hospital outputs indicator.	Frequency of admissions per bed (adjusts for the impact of the difference in the number of beds between hospitals).
There is evidence of moral hazard associated with the insufficiency of the "hospital exits" indicator in differentiating hospitalizations, due to the preferential selection of less complex hospitalizations.	Comparison of the proportion of less complex hospitalizations in the production of hospitals linked and not linked to the indicator.	Frequency of less complex hospitalizations (considered in this study as those with up to 02 days of hospitalization, excluding discharges due to death).
There is evidence of the moral hazard of "hospital exits" associated with the indicator by reducing the consumption/cost of hospitalizations.	Comparison of the average length of stay of hospitalizations between hospitals linked and not linked to the indicator.	Average dwell time considered as an estimate of resource consumption in the absence of cost data[20].

Source: Elaborated by the author.

Once we had tested the possibility of moral hazard in relation to the insufficiency of the "hospital discharges" indicator, we tried to assess the potential of the SIH/SUS variables in differentiating hospitalizations, which could be used in the proposal for a new indicator. Thus, the classification of procedures in the SUS Table was used as a basis for forming homogeneous groups that are manageable[14], in order to meet the following criteria: (1) homogeneous classes from a technical point of view and in terms of resource consumption, (2) having a manageable number of classes, and (3) using data available in hospital information systems. It should be noted that hospitalizations with a length of stay of more than 30 days were disregarded, given the frequent association in these cases of more than one disease recorded under the same main procedure.

The classification of hospitalizations by main procedure in the SUS Table was used as the criterion for grouping hospitalizations, as it has the greatest technical homogeneity between the elements. The weighting of these hospitalization groups was established using two factors. The first was the average length of stay, assumed as an estimate of resource consumption (consumption/cost varies positively with hospital stay). Even though it is understood that this is a partial assessment, in the absence of cost information, this choice is justified by the availability of data, its objectivity (it is a less subjective measure than the cost of hospitalizations, considering the multiplicity of factors that interfere with hospital costs), and because it is related to the greater likelihood of changes in the service provider's behavior, given the ease of comparison with the performance of similar services[20].

Two tests were used to assess the constancy of length of stay as a weighting factor for hospitalization groups: (1) the dispersion of length of stay in each group in relation to the mean (standard deviation), total and according to age groups (up to 12 years, between 12 and 60 years and 60 years and over) and (2) the regularity of the average length of stay for the same procedure in different samples, which had the quarters of 2019 as the selection criterion, considering the need to guarantee a minimum frequency.

A second factor used to differentiate the weight of hospitalizations was the value assigned to each hospitalization in the SIH/SUS. Each primary procedure identifying the hospitalization is associated with a value in Brazilian Reais (BRL) in the SUS Table. In the previous financing model for hospital care, this value was used to cover the cost of hospital infrastructure, professional services, and less complex diagnostic tests. It could also be increased by values assigned to procedures considered special in this table, as recorded in the AIH based on their utilization. The assumption tested is that the value of hospitalization in the SIH/SUS correlates positively with the complexity of hospitalizations, assuming that more complex hospitalizations require a greater number of special procedures. This value could therefore be used as a weighting factor for the proposed new indicator.

The hospitals representing the management models in this study were selected based on their similarities with the size and production profile of the HS, which is the sole representative of the PPP management model in the state. Based on this reference, hospitals managed by OS and those with direct management were se-

lected according to two exclusion criteria (being a general hospital and primarily serving open demand) and four classification criteria: (1) number of general beds, (2) number of ICU beds, (3) proportion of clinical/surgical admissions, and (4) relative frequency of admission types classified by organ system (e.g., endocrine diseases, diseases of the digestive system) or by surgical subspecialty (e.g., neurosurgery for tumors, spinal neurosurgery). The HGCA, representing direct management, and the HRSAJ, representing OS management, were selected based on these criteria.

Considering the operational limits of the research, the analysis of hospitalization groups was restricted to the four most frequent procedures performed in the selected hospitals (two clinical and two surgical), as outlined in Table 1.

Table 1: Selected procedures - 2019

Desciption	HGCA	HS	HRSAJ	Total*
Treatment of stroke (ischemic or acute hemorrhagic)	567	334	1.420	2.321
Treatment of pneumonia or influenza (flu)	111	373	598	1.082
Appendectomy	146	250	392	788
Surgical treatment of tibial shaft fractures	74	207	120	401

Source: SIH/SUS[21]

* The totals per procedure do not include hospitalizations of more than 30 days.

It should be noted that the source of the data on the production of hospitalizations is SIH/DATASUS, because, despite criticisms of this database, it is the main instrument for inducing and evaluating policies related to the organization and financing of medical and hospital care in the public health system, considering the large volume of data that is easily accessible and made available on time[22]. The selection of a one-year period for hospital admissions took into account: (1) that the number of admissions in each class was sufficient to establish the possibility of a standard average length of stay and (2) the need to control for the effects of possible variations due to the seasonality of hospital admissions. 2019 is the last year to be consolidated in the SIH/SUS database, since the DATASUS database can be updated up to 6 months after the patient is discharged. In addition, due to the effects of the COVID-19 pandemic, 2020 was considered atypical for hospital production.

Table 2: Frequency of hospitalizations in selected hospitals, year 2019

Hospital	Approved	Administrative high-ups	Considered
HGCA	7.720	591	7.129
HRSAJ	10.512	1.274	9.238
HS	15.912	1.804	14.108
TOTAL	34.144	3.669	30.475

Source: SIH/SUS[21]

Note: In cases of administrative discharge, patients remain in hospital and are not considered “hospital exits”.

According to Fetter[14], hospital admissions should be measured by forming groups of admissions that are similar in terms of clinical attributes, the care process and cost, so that they are as homogeneous as possible, making it possible to standardize the process of producing them and setting targets that will serve to evaluate the results. The classification of admissions into homogeneous groups should be based on information routinely collected in hospitals and each group should have a sufficient frequency of admissions to justify its designation. This recommendation corroborated the reason for choosing the classification of hospitalizations according to the main procedure of the SIH/SUS as the reference for the proposal of the weighted hospitalization frequency indicator suggested in this study, considering the technical similarity (clinical attributes and care process).

RESULTS

The alignment between the interests of the principal and the agent will depend on how the result is measured and the reward system associated with it. The "hospital discharges" indicator measures the output of admissions under hospital management contracts. Each hospital discharge considered in the outcome of the hospital discharges indicator encompasses all the services provided to the patient during hospitalization (assessments, tests, medicines, procedures and others) that made up their treatment, and in this respect is in line with the best technical references[14,23].

Two technical parameters are taken into account when defining the target for the hospital outputs indicator: the maximum percentage of occupancy of installed capacity and the shortest average length of stay for producing quality hospitalizations. In these terms, achieving the target will reflect the result of maximum utilization of installed capacity and the best possible technical performance. In order to assess whether the "hospital outflows" indicator, associated with the incentives provided for in the management contracts, is related to greater productivity in terms of admissions, we compared the output of the direct management model, with no provision for hospital outflow targets, with the output of hospitals in the OS and PPP models, in which targets are provided for in the contracts. The results are shown below.

Table 3: Productivity of selected hospitals, 2019.

Criterion	Direct	OS	PPP
Number of beds	285	150	313
Total hospitalizations	7.129	9.238	14.108
Total daily hospital charges	67.479	46.534	108.445
Admissions per bed	25	62	45
Occupancy rate	65%	85%	95%
Average length of stay (days)	9,5	5,0	7,7

Source: CNES[24] e SIH/SUS[21]

It can be observed that the hospital under direct management, not linked to the "hospital outflows" indicator, produced 25 admissions per bed in 2019. In contrast, the PPP model generated 45 admissions per bed, and the OS model produced 62 admissions per bed, both regulated by the "hospital outflows" indicator. As previously discussed, this performance difference may be related to the two key parameters of the hospital outflows indicator shown in the table: occupancy rate (which is lower in the hospital under direct management) and average length of stay (which is higher in direct management).

The suggestion that the direct management model is less efficient, based on these results and the reference to its technical and operational quality, may be connected to the incidence of moral hazard. This is linked to the financing model's budgeting not being tied to performance evaluation. Such a model ensures revenue stability for the service provider but does not incentivize performance improvement. When revenue does not vary with production, and in the absence of other incentives, the agent may use their informational advantage to perform the work with less effort, thus maximizing their utility. Consequently, future studies could explore whether performance evaluation mechanisms can stimulate efficiency in the direct contracting model.

Although the "hospital outflows" indicator stimulates productivity by counting hospital admissions indiscriminately, it disregards differences in cost and complexity. This can lead to moral hazard in the following way: the service provider may prioritize simpler admissions to meet the indicator's target, as these involve less effort and lower costs. In the global budget financing model used in these contracts, this could result in greater profit. To investigate this, the frequency of low-complexity hospitalizations across different management models was evaluated. A hospital stay of up to two days was used as a criterion for lower complexity, excluding cases of death. The results are presented in Table 4.

Table 4: Frequency of admissions by length of stay in selected hospitals

Hospital	> 02 days	Up to 02 days	TOTAL	% ≤ 02 days
Direct management	4.540	2.302	6.842	34%
OS	4.048	4.943	8.991	55%
PPP	9.655	4.104	13.759	30%

Source: SIH/SUS[21]

It can be observed that the proportion of less complex hospitalizations in the OS management model (55%) is 1.6 times higher than in the direct management model (34%) and 1.8 times higher than in the PPP management model. The high frequency of these less complex hospitalizations in the OS model, many of which involve treatments that could be resolved in an outpatient setting, compared to their frequency in other models, suggests a potential moral hazard. This may involve favoring less complex hospitalizations to occupy hospital capacity. Additionally, this undermines the results-based contract logic, as the provider receives the incentive without fulfilling the contract's objective. The indicator's inability to differentiate between types of

hospitalizations encourages inefficiency in the health system by inducing unnecessary demand for low-complexity hospitalizations with questionable indications.

A third potential moral hazard assessed in this study involves the strategy of reducing the length of hospital stays to cut costs, which could compromise quality. To investigate this, the variation in the average length of stay for selected procedures across different management models was evaluated.The results are shown in Table5.

Table 5: Average length of stay (TMP) per procedure, by management model in selected hospitals, 2019

Procedure	Average Lenght of Stay (days)		
	Direct	OS	PPP
Treatment of cerebrovascular accident – AVC	6,7	7,2	8
Treatment of pneumonia or influenza (flu)	8,2	5,2	8,1
Appendectomy	2,8	2,7	2,7
Surgical treatment of tibial shaft fractures	5,6	2,3	5,3

Source: SIH/DATASUS[25].

It can be seen that in two of the selected procedures, the average length of stay of the hospital managed by a SO is well below the average of the direct management and PPP models: treatment of pneumonia or influenza (flu) of 5.2 days and surgical treatment of a tibial shaft fracture of 2.3 days, a performance not observed in hospitalizations for stroke treatment and appendectomy, in which the average lengths of stay are similar. These results do not confirm the assumption of the incidence of moral hazard related to the strategy of reducing the average length of stay, possibly limited by professional ethical principles associated with the legal risk of lawsuits for medical errors. The shorter length of stay observed in the OS in hospitalizations for pneumonia and tibial fractures may be related to the over-indication of less complex hospitalizations, discussed above, considering that the subjectivity involved in the indication of these hospitalizations is greater than for stroke and appendectomy hospitalizations, which are generally linked to diagnostic imaging tests.

WEIGHTED HOSPITALIZATION FREQUENCY INDICATOR (FIP)

To assess the occurrence of a pattern in the classes of hospitalizations defined on the basis of the main procedure, we used the parameter average length of stay of hospitalizations for the procedures selected in this study. Homogeneity was assessed by measuring the dispersion of hospitalization lengths of stay in relation to their respective mean in each group, using the standard deviation. The results are shown in Table 6.

Table 6: Average length of stay and standard deviation per procedure in selected hospitals, 2019

Procedure	Average lenght of stay	Standard deviation
Treatment of cerebrovascular accident – AVC	7,6	5,9
Treatment of pneumonia or influenza (flu)	8,1	6,0
Appendectomy	2,7	1,9
Surgical treatment of tibial shaft fractures	5,4	4,9

Source: SIH/DATASUS[25].

As can be seen, the value of the standard deviation of the time spent in each procedure represents at least 70% of the value of the average, characterizing great dispersion. Following the theoretical framework[14], the average lengths of stay for hospitalizations by procedure were assessed by patient age group, in three groups: up to 12 years old, between 12 and 60 years old, and 60 years old or more, based on the assumption that the specificities of these age groups may have an impact on the complexity of hospitalizations. In this case, the average length of stay for the same type of procedure could differ between age groups, but the standard deviation from the average by age group should be less than the dispersion of the overall average length of stay for each type of procedure. The results are shown below.

Table 7: Average length of stay (TMP) and standard deviation (Dp) per procedure by age group in selected hospitals, 2019

Procedure	Up to 12 years old		>12 and <60 years old		More than 60 years old	
	TMP	Dp	TMP	Dp	TMP	Dp
Treatment of cerebrovascular accident – AVC	*	*	7,7	6,0	7,6	5,9
Treatment of pneumonia or influenza (flu)	6,4	4,2	8,0	6,3	8,8	6,2
Appendectomy	4,1	2,1	2,5	1,7	3,1	3,0
Surgical treatment of tibial shaft fractures	2,3	0,8	5,7	5,1	*	*

Source: SIH/DATASUS[25].

Note: * Sample disregarded for having N < 15.

In general, the average length of stay of hospitalizations for the same procedure in the different age groups is similar to the general average, with the exception of hospitalizations for pneumonia and appendectomy in children under 12. In addition, the dispersion of hospitalization lengths of stay in relation to the mean (standard deviation) remains high in all the age groups considered, demonstrating that the age group variable does not contribute to homogeneity in the classification of hospitalization by procedure.

According to Fetter[14], secondary diagnoses (comorbidities and complications) associated with the main procedure of hospitalization should be taken into account when forming homogeneous groups; however, although this data is provided, it is not fed into the SIH/DATASUS database, which is one of the main criticisms of this system[26]. In the absence of this information, it is not possible to make progress in implementing the homogeneity of groups classified on this basis.

Despite the lack of homogeneity of the hospitalization groups defined according to the main procedure of the IHA in terms of the consumption of resources estimated by the average length of stay, technical homogeneity is preserved. Each group is associated with a specific diagnosis that can be supported by a treatment protocol, for which a standard average length of stay can be established, even if considerable dispersion has to be tolerated. This possibility is reinforced by the consistency of the average length of stay for each procedure in different periods, as shown in Table 8.

Table 8: Average length of stay per quarter in selected hospitals, 2019

		By quarter 2019			
Procedure	**General 2019**	**1st**	**2nd**	**3rd**	**4th**
Treatment of cerebrovascular accident – AVC	7,6	7,7	7,5	8,0	7,1
Treatment of pneumonia or influenza (flu)	8,1	7,5	7,9	8,5	8,5
Appendectomy	2,7	2,7	3,1	2,6	3,6
Surgical treatment of tibial shaft fractures	5,4	4,6	5,4	5,8	5,9

Source: SIH/DATASUS[25].

It can be seen that the overall average length of stay in 2019 is very close to that assessed by quarter for each of the procedures analyzed, with the maximum variation being 16% (surgical treatment of tibia fracture, 1st quarter). This consistency in the average length of stay suggests the occurrence of a treatment pattern for hospitalizations with the same main procedure.

A second condition needed to establish the homogeneity of the groups is the cost of hospitalizations. Although this information is not available in the SIH/SUS, each hospitalization in this database is associated with a value corresponding to the sum of the SUS table values of the procedures performed. With this in mind, we evaluated the possibility of using this variable to differentiate between groups of hospitalizations, under the assumption that the complexity of hospitalizations varies positively with the value of the hospitalization in the SIH/SUS. To assess this assumption, the average values of hospitalizations for the same main procedure in the different management models were compared, as shown in Table 9.

Table 9: Average value (R$) of hospitalizations per procedure by management model and proportion in relation to the overall average value (%), in selected hospitals, 2019

Procedure	Overall average value	Direct		OS		PPP	
		R$	%	*R$*	%	*R$*	%
Treatment of cerebrovascular accident – AVC	1.352,77	900,00	0,7	1.352,21	1,0	1.533,68	1,1
Treatment of pneumonia or influenza (flu)	1.350,19	1.148,68	0,9	914,58	0,7	1.659,31	1,2
Appendectomy	577,80	616,69	1,1	450,63	0,8	644,42	1,1
Surgical treatment of tibial shaft fractures	1.633,69	1.813,45	1,1	1.530,51	0,9	1.700,85	1,0

Source: SIH/DATASUS[25].

The average value of hospitalizations for stroke treatment in the hospital under direct management is lower than in the OS and PPP models, which suggests that the number of special procedures performed in direct management hospitalizations was, on average, lower in this type of hospitalization than in other management models. The lower average value of admissions for treatment of pneumonia or influenza and admissions for treatment of fractures of the diaphysis of the tibia in the OS model is in line with the evidence of lower complexity of these admissions suggested in the evaluation of the average length of stay, as discussed above.

In view of these results, it is understood that the average length of stay and the average value of hospitalizations recorded in the SIH/SUS are different between the hospitalization groups classified by main procedure, and that despite their limitation in terms of effective correspondence with the complexity of hospitalizations and with the cost/consumption of resources, these are the variables available in the national database that bear some relation to the differentiation of hospitalizations. Based on this premise, it is proposed that they be used as a weighting factor for calculating the FIP, the indicator proposed in this study for evaluating the performance of inpatient services in public hospital management contracts.

DEFINING THE FREQUENCY OF WEIGHTED HOSPITALIZATIONS (FIP) INDICATOR

The FIP is then defined as the sum of the frequencies of hospitalizations classified by main procedure, weighted by the average standard length of stay, corrected by the relative weight of the average value of the procedure in the hospital evaluated in relation to the average reference value in the state, in the period considered, expressed using the following formula: $FIP = \Sigma [FP_{n.} \times TMPP_n \times (VM_n/VMP_n)]$, where:

FP_n = Frequency of hospitalizations from the hospital discharge frequency procedure.

$TMPP_n$ = Standard average length of stay for the procedure.

VM_n = Average value of hospitalizations for the procedure in question, in the hospital evaluated.

VMP_n = Average reference value of hospitalizations for the procedure.

Based on these definitions, the FIP calculation was simulated for the procedures and hospitals analyzed in this study, using the average length of stay per procedure and the average total value of admissions per procedure at the three hospitals as standard reference values. The results of this simulation for the procedures evaluated in each management model, using the FIP formula, are shown below:

Table 10: FIP simulation by management model for selected procedures, 2019

Procedure	Management	FP	TMPP	VM	VMP	VM/VMP	FIP
Treatment of cerebrovascular accident – AVC	Direct	567	7,6	900,00	1.352,77	0,7	2.867
Treatment of pneumonia or influenza (flu)		111	8,1	1.148,68	1.350,19	0,9	765
Appendectomy		146	2,7	616,69	577,80	1,1	421
Surgical treatment of tibial shaft fractures		74	5,4	1.813,45	1.633,69	1,1	444
Subtotal direct management		898					4.496
Treatment of cerebrovascular accident – AVC	OS	334	7,6	1.352,21	1.352,77	1,0	2.537
Treatment of pneumonia or influenza (flu)		373	8,1	914,58	1.350,19	0,7	2.047
Appendectomy		250	2,7	450,63	577,80	0,8	526
Surgical treatment of tibial shaft fractures		207	5,4	1.530,51	1.633,69	0,9	1.047
Subtotal OS		1.164					6.158
Treatment of cerebrovascular accident – AVC	PPP	1.420	7,6	1.533,68	1.352,77	1,1	12.235
Treatment of pneumonia or influenza (flu)		598	8,1	1.659,31	1.350,19	1,2	5.953
Appendectomy		392	2,7	644,42	577,80	1,1	1.180
Surgical treatment of tibial shaft fractures		120	5,4	1.700,85	1.633,69	1,0	675
Total		2.530					20.043

Source: SIH/SUS[21].

In the direct management model, the FIP result for the production of 146 appendectomy admissions is lower than the result for 111 admissions for pneumonia or influenza treatment, as the weight of their TMPP (Time and Materials Payment Point) is three times lower. This difference is adjusted by 10% when considering the VM (Value of Materials) criterion, suggesting that a greater number of special procedures were performed in these admissions under direct management than the average of the three hospitals used as a benchmark in this simulation.

In the OS model, 334 hospital admissions for stroke treatment corresponded to 2,537 FIP points, based on the TMPP weight of 7.6, without correcting for VM, which in this case has a weight of 1. When comparing this result with the direct management model, it can be seen that although the frequency was 70% higher in the direct management model (567 admissions), the difference in the FIP result was only 37% higher (2,867 points). According to the assumptions presented, this performance difference is attributed to the FIP's sensitivity to the lower complexity of stroke treatment admissions in the direct management hospital. This same rationale explains the difference observed when comparing the total results of the OS and PPP models: the PPP's performance is twice as high as the OS in hospital outputs, and three times higher when measured using the FIP. The indicator sheet summarizing the main parameters is shown in Table 3.

Chart 3: FIP Indicator Sheet.

Frequency of Weighted Hospitalizations (FIP)	
Definition	Frequency of hospitalizations weighted by the average standard length of stay and the average value of the AIH in the hospital and period considered.
Interpretation	It measures the number of admissions per hospital by assigning different weights to each type of admission identified by the main procedure in the IHA. The weights are proportional to the consumption of resources, estimated on the basis of the average standard length of stay and the average value of the AIH for the procedure in the state.
Calculation method	Sum of the products of hospitalization frequencies (FPn) times the average standard length of stay per procedure (TMPPn), times the proportion that the average value of the procedure in the evaluated hospital (VMn) represents the standard mean value of the procedure (VMPn) in the state. FIP = Σ [FPn. X TMPPn x (VMn/VMPn)] It is suggested that in the absence of any other technical reference, the parameters of average standard length of stay per procedure (ASLOS) and average standard value of the procedure (ASV) should correspond to the averages measured on the basis of the production of state hospitals in the year in question.
Source	SIH/SUS
Reference Value	It corresponds to the hospital's total bed days for a 90% occupancy rate. In more complex hospitals, the reference value should be increased due to the expectation of a greater difference in the cost of their hospitalisations in relation to the average cost of hospitalisations in the state.

Frequency	Quarterly
Update	Annual, or based on standardisation studies/hospitalisation protocol
Scope	State public hospitals
Dimension	Efficiency

Source: Elaborated by the author, based on FIOCRUZ[27].

The study proposes a new indicator, which, after testing, has identified aspects that should be considered in future studies. However, there are limitations to take into account. The relationship between the weight assigned to different types of hospitalizations, based on the average length of stay and the average value of the AIH, is not directly correlated with the complexity and cost of hospital admissions. This relationship is influenced by factors not controlled by the indicator, such as the frequency and type of secondary diagnoses and distortions in the SUS table values. The indicator is useful for comparing a hospital's performance over time and between different hospitals within the same period, assessed using the same parameters, until the SIH/SUS database can support more specific assessments.

Significant discrepancies in performance when evaluating this indicator should prompt on-site control actions, including the examination of medical records to identify and address potential causes. The parameters should be reassessed as studies based on the improved database become available.

FINAL CONSIDERATIONS

The alignment between the logic of moral hazard in each management model and the differences observed in the research results strongly suggests the presence of this risk in the management of public hospitals in Bahia, partially due to the inadequacy of the hospital outputs indicator as a performance evaluation measure. By allowing the provider to meet the target and receive the corresponding financial reward by favoring less complex hospitalizations, the indicator disrupts the alignment of objectives between principal and agent, which is essential for ensuring the contract's efficiency, and creates opportunities for the provider to exploit their informational advantage. This loss of efficiency in the hospital system can significantly undermine the guarantee of the right to health within the SUS, especially in a context of increasing demand and limited resources.

The results for PPP management did not show as high a proportion of less complex hospitalizations as those under OS management, despite both being linked to the hospital outputs indicator. This difference may be attributed to the private partner's prerogatives in decision-making involving project execution, as stipulated in the contract's governance structure. According to the SUS/BA Audit28, during the contract's execution, the service provider in the PPP did not meet the target for hospital outputs yet received the full reward, arguing that the state's failure to fulfill its responsibilities compromised its performance.

The FIP is justified by its potential to mitigate moral hazard, as it considers the technical differences and complexities of hospital admissions. It is also associa-

ted with a shift in perspective regarding the hospitalization production process, which is now measured through horizontal production lines organized by technically homogeneous groups of hospitalizations that can be standardized and monitored.

As discussed, the primary limitations of this study are related to the quality of the SIH/SUS database. The lack of information on secondary diagnoses of hospitalizations restricted the study methodologically to descriptive statistics of the sample and limited the ability to test hypotheses related to variations in mean and standard deviation. The criterion for selecting the sample of admissions, based on one hospital unit per model, does not satisfy the representativeness required to generalize the study's conclusions.

On the other hand, the use of the SIH/SUS in the manner proposed by the FIP will contribute to improving the quality of the information and, consequently, the consistency of this database, thus expanding possibilities for new studies. Descriptive research that identifies other independent variables potentially related to the intensity of resource consumption in hospital admissions, and that advances in determining the nature of this relationship to make the classification of admissions increasingly homogeneous, is essential. Once this classification is consolidated, studies based on random and representative samples will be necessary to describe the characteristics of each homogeneous group, aiding in refining performance evaluation parameters in hospital management contracts and identifying any specific characteristics of SUS patients in state public hospitals that may cause performance parameters to deviate from the best scientific references. Finally, explanatory studies will be needed to investigate the causes of these potential variations and propose appropriate solutions.

As we can conclude, this is a vast field for scientific research that remains largely unexplored and initially depends on improving the quality of the SIH/SUS database. This improvement will be proportional to the extent to which the data is used and subjected to rigorous critical evaluation, requiring the involvement of all stakeholders. An indicator sensitive to differences in hospital admissions, with targets linked to rewards in hospital management contracts, could be an effective starting point for this process. However, the implementation of indicators is only the first step in a process that still has much to be developed.

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