

ISO 41001-Based Diagnosis of a Hospital Facility Management System

Diagnóstico basado en la norma ISO 41001 de un sistema de gestión de instalaciones hospitalarias en Colombia

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Abstract

Introduction: this study presents the application of a diagnostic tool to a Facility Management System based on the ISO 41001 standard in a Colombian hospital. The purpose is to assess the maturity level of the management system and its alignment with international best practices in hospital facility administration.

Objectives: the study aims to evaluate the management system of a Colombian hospital according to the criteria established by ISO 41001 and the main areas of Facility Management, in order to identify strengths, weaknesses, and opportunities for improvement.

Methodology: the assessment was conducted through the application of three questionnaires: the first two focused on the main components of the Facility Management System, and a third one addressing the system's environment. This methodology enabled a comprehensive analysis of the interaction between macroprocesses and hospital departments.

Results: the results show that the evaluated institution achieved a high score and meets most of the standard's requirements. However, specific gaps were identified that need to be addressed to strengthen management practices and ensure a more efficient implementation of the system.

Conclusions: this study provides an innovative and easily applicable diagnostic approach for other Colombian hospitals. The tool allows the identification of gaps between departments and highlights the interaction among the different areas of the Hospital Facility Management System. It thus serves as a useful foundation for progressing toward an integrated management system aligned with healthcare quality standards.

Keywords: Diagnosis tool; facility management; management system; healthcare sector.

Resumen

Introducción: este trabajo presenta la aplicación de una herramienta de diagnóstico a un Sistema de Facility Management basado en el estándar ISO 41001 en un hospital colombiano. El propósito es evaluar el nivel de madurez del sistema de gestión y su alineación con las buenas prácticas internacionales de administración de instalaciones hospitalarias.

Objetivos: el estudio busca calificar el sistema de gestión de un hospital colombiano según los criterios del estándar ISO 41001 y las principales áreas del Facility Management, con el fin de identificar fortalezas, debilidades y oportunidades de mejora.

Metodología: la evaluación se realizó mediante la aplicación de tres cuestionarios: los dos primeros centrados en los componentes principales del Sistema de Facility Management y un tercero enfocado en el entorno del sistema. Esta metodología permitió analizar integralmente la interacción entre los diferentes macroprocesos y departamentos hospitalarios.

Resultados: los resultados indican que la institución evaluada alcanza una puntuación alta y cumple con la mayoría de los requisitos del estándar. Sin embargo, se evidencian brechas específicas que requieren atención para fortalecer la gestión y garantizar una implementación más eficiente del sistema.

Conclusiones: el estudio ofrece un diagnóstico novedoso y de fácil aplicación en otros hospitales colombianos. La herramienta permite identificar brechas entre departamentos y reconocer la interacción entre las distintas áreas del Sistema de Facility Management Hospitalario, constituyéndose en una base útil para avanzar hacia un sistema de gestión integrado y alineado con los estándares de calidad en salud.

Palabras clave: Herramienta de diagnóstico; facility management; sistema de gestión; sector salud.

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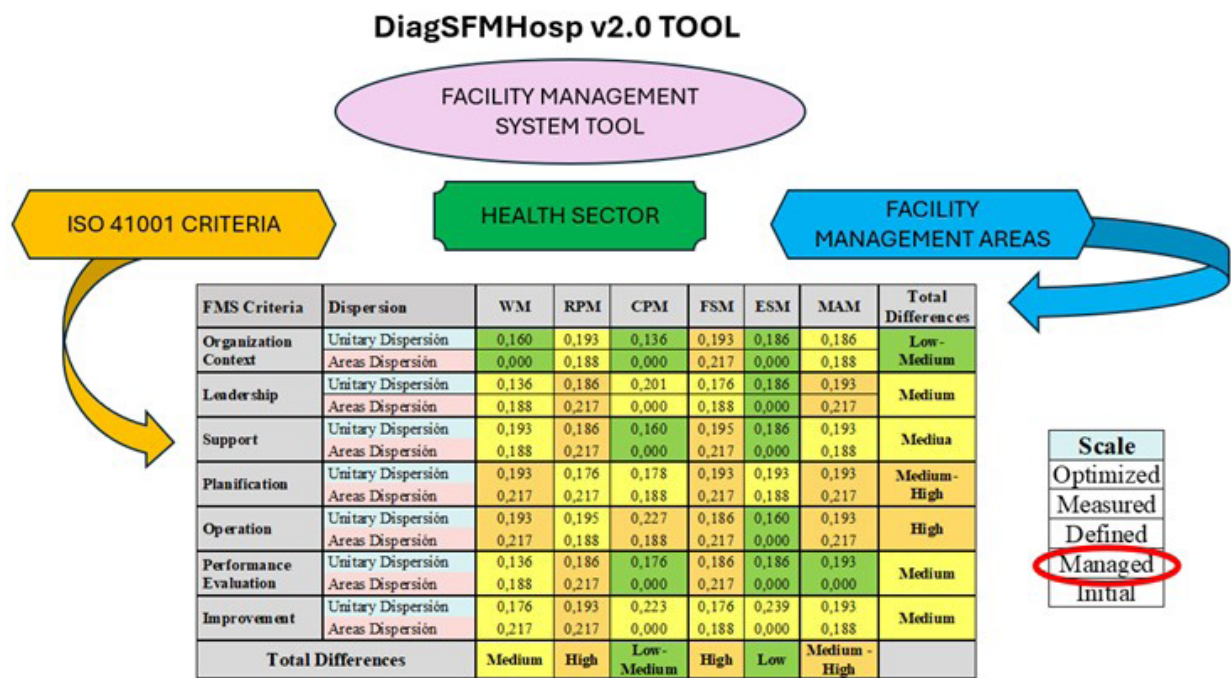
Spanish version



Why was this study conducted?
The “DiagSFMHosp v2.0” tool, based on ISO 41001, was applied to diagnose the maturity level of the Facility Management System (FMS) in a Colombian institution, identify strengths, weaknesses, and barriers, and compare the High-Level Structure criteria and key FM areas as a preliminary step toward an integrated system aligned with healthcare quality standards.

What were the most relevant findings?
Weighted score $ZD = 0.76$ “MEASURED” maturity level; the organization meets most requirements and maintains accessible documentation. Homogeneity in Context, Leadership, and Planning; gaps in Support, Operation, Performance Evaluation, and Improvement.
In FM areas, Corporate Project Management and Energy & Sustainability Management showed a uniform vision but lower scores; Workplace Management, Real Estate & Property Management, Facilities Services Management, and Maintenance & Asset Management achieved higher scores with greater dispersion across areas.
Management system environment: strong willingness to implement standards and current accreditations, interest in The Joint Commission International (~89%); main impediments identified were cost–benefit concerns, lack of time, staff participation, and the risk of documentation bureaucratization.

What do these findings contribute?
They offer a replicable diagnostic tool for Colombian hospitals that quantifies gaps by High-Level Structure criteria and FM areas, guiding action plans to integrate an SFM compliant with ISO 41001 and align it with sector accreditations. They help prioritize operational improvements (support, operation, evaluation, improvement) and focus development on lower-performing areas.



Introduction

The authors of this study agree that, in accordance with ISO 41001 (1), Facility Management (FM) is a discipline that integrates various professions "...in order to influence the efficiency and productivity of the economies of societies, communities, and organizations, as well as the way individuals interact with the built environment." Thus, FM encompasses support activities and services, providing added value to real estate asset management, thereby strengthening organizational resilience (2). In the healthcare sector, FM functions are often delegated to clinical engineering, hospital engineering, or physical infrastructure departments (3); however, its impact extends to all departments, even influencing patient and client satisfaction (4).

Like other management system standards (MSS) related to quality, environment, risk management, and occupational safety, among others, ISO 41001 (1) establishes a set of coordinated elements that interact at various levels for the development of organizational policies and objectives. This framework provides the foundations for directing and verifying organizational actions, ensuring that the goals defined by top management in relation to FM activities are achieved (5). However, to implement a Facility Management System (FMS), it is necessary to assess the current management system (MS) in the healthcare institution, which will allow the establishment of action plans that facilitate the integration of the FMS in accordance with ISO 41001 guidelines. Additionally, it is essential to identify the barriers to implementing this type of standard (6).

Through a literature review on asset management and hospital infrastructure systems diagnoses, the authors of this work observed limited research in this field. Many companies already had tools for certifying ISO management systems standards (quality, environmental, energy, and even asset management) (7), but they had developed FM diagnostic tools since these standards were introduced in 2018.

In this context, the purpose of this study is to diagnose the FMS through a case study in a Colombian healthcare institution, using an improved version of the tool previously employed in Spanish hospitals (8). The new diagnostic tool, called "DiagSFMHosp v2.0," aims to identify strengths, weaknesses, and barriers within each department, enabling an effective understanding and implementation of the FMS within the organization. This study seeks to identify the different gaps existing in FM, both in the High-Level Structure (HLS) criteria and in the main areas of the FM (9), considering the values of the mode and the dispersion of the data. Its aims to analyze how the FMS environment in the Colombian health institution compares with other MSS, without proposing specific alternatives for closing the gaps, which will be the subject of another study.

This paper hypothesizes that the adoption of standardized FM methodologies and practices, such as those promoted by ISO-type systems, allows for the optimization of organizational performance in healthcare institutions. Such standardization is expected not only to improve operational quality and support processes but also to have a positive impact on patient care, hospital efficiency, and financial results (10). Furthermore, it is anticipated that the implementation of a FMS will vary in its development and maturity depending on the institutional context, organizational structure, and the level of knowledge of the personnel involved.

Materials and methods

To conduct this case study on the diagnosis of the FMS using the “DiagSFMHosp v2.0” tool, it was necessary to arrange interviews with employees from various departments of the Clínica Universitaria Bolivariana CUB) in Medellín. Both virtual and in-person meetings were scheduled for this purpose. This institution is authorized as a High Complexity Healthcare Provider SUH, acronym in Spanish) by the Department of Antioquia’s Health Secretariat, holds the National Health Accreditation SUA, acronym in Spanish) [\(11\)](#) granted by Colombian Institute for Technical Standards and Certification ICONTEC), is certified as a “University Hospital” by the Ministry of Health and Social Protection, and is ranked among the 30 best clinics in Latin America [\(12\)](#).

Subsequently, the authors of this study reviewed the organizational chart and process map of the institution to identify the key stakeholders who would participate in the interviews. The CUB’s organizational chart revealed six functional areas encompassing both core and support activities in healthcare services: General Management, Scientific Management, Healthcare Management, Planning and Quality Management, Administrative and Financial Management, and Commercial Management.

In addition to functional areas, the research also required identifying the macroprocesses outlined in the institution’s process maps. This ensured that the interviewees belonged to these areas. Based on a sample analysis of at least ten process maps from Colombian hospitals of various care levels according to complexity), macroprocess areas were generally grouped into four main categories: strategic, core, support, and evaluation and control. However, upon reviewing CUB’s process map, a different grouping was identified, consisting of four areas: strategic, healthcare, teaching and research, and support. This classification was discussed with Dr. Acevedo, the coordinator of the interviews between the authors and the CUB, who explained that the “Support” area had been merged with “Evaluation and Control” in this institution. Furthermore, reviewing CUB’s macroprocess distribution highlighted the importance of the coexistence of the Teaching and Research area with the Healthcare area, as both comprise the core processes that enabled CUB to obtain “University Hospital” certification from Colombia’s Government.

After analyzing the six functional areas and the four macroprocess areas at CUB, a specific number of employees working in different institutional sectors were selected to obtain a comprehensive perspective of the organization’s operations. The methodology of this study was structured into seven sections:

a) In-Person/Virtual interviews with hospital employees

The authors of this study requested the participation of at least two individuals from each of the hospital’s four main macroprocess areas: Management strategic), Medical Healthcare), Research Teaching & Research), and Support support services). In response, the CUB hospital management) delegated the task to 14 key staff members: 3 from the Management department, 3 from the Medical/Nursing department, 2 from the Teaching & Research department, and 6 from the Support

Services department. The selection process began by ensuring the involvement of more than 50% of the department leaders/heads (the CUB has less than 20 departments) (13) or, at a minimum, had to be 9 participants for this sample. Additionally, all selected participants had been affiliated with the institution and held their current roles for at least three years, ensuring they possessed sufficient knowledge of the hospital's operations. All participants met the inclusion criteria and were approved to take part in the study.

The selected CUB employees were interviewed through both in-person and virtual modalities. During the interviews, they were given Questionnaire A, consisting of 71 questions based on the seven criteria of the ISO 41001 standard, and Questionnaire B, which included seven questions related to the six FM areas. Before starting, participants received an informational session on FM and MS to introduce them to these topics. They were also encouraged to share suggestions on the interview topics. After the session, a structured version of Questionnaire C was sent via email to assess CUB's management system environment (14).

b) Scoring system for the “DiagSFMHosp v2.0” tool

To analyze the interview results, a scoring system was implemented for the responses to questionnaires A and B for gap analysis with a growth similar to the Dupont Bradley curve (15). As mentioned earlier, responses to the seven HLS criteria of the FMS Table 1) align with the maturity levels proposed by the Institute of Asset Management (16), which include: Innocent, Aware, Developing, Competent, and Optimizing. Responses were classified using a Likert scale with five levels: very low, low, medium, high, and very high. Additionally, these responses were associated with exponential growth percentages ranging from 0 to 1, as detailed in the third and fourth columns of Table 1.

Table 1. Scoring system for responses in the HLS criteria of the FMS

| Project Response | IAM Response | Rating | Range | Average Score |
|-------------------|--------------|-----------|-------------|---------------|
| DK/NA | Innocent | Very Low | 0 | 0 |
| Not Implemented | Aware | Low | 0 - 0,10 | 0,05 |
| Drafted | Developing | Medium | 0,10 - 0,30 | 0,2 |
| Being Implemented | Competent | High | 0,30 - 0,80 | 0,6 |
| Being Improved | Optimizing | Very High | 0,80 - 1,00 | 0,9 |

Source: the authors.

A numerical score was assigned to each response using three scenarios: optimistic, moderate, and pessimistic. The optimistic scenario assumes the organization meets high standards in FMS implementation. The moderate scenario assumes compliance levels typical of a SUA. The pessimistic scenario assumes the organization does not meet the minimum FMS requirements, though this is less likely. The assigned numerical score 0; 0.05; 0.2; 0.6; 0.9) corresponds to the average of the interval's extremes (fourth column), representing the moderate scenario, as shown in the fifth column of Table 1.



On the other hand, the responses related to the main areas of FM (9) are expressed as follows: None, Partial, and Complete. This scoring system is associated with a Likert scale ranging from Low minimum) to High maximum), as indicated in the second column of Table 2. Furthermore, these responses are linked to staggered percentages of linear growth, from 0 to 1. For each scenario optimistic, moderate, pessimistic), a moderate numerical score was selected, calculated from the average of the extreme values of the intervals, which are represented in the third column of Table 2.

Table 2. Scoring system for responses to FM areas in the FMS

| Response | Rating | Range | Score |
|----------|--------|-------------|-------|
| None | Low | 0 - 0,25 | 0,125 |
| Partial | Medium | 0,25 - 0,75 | 0,5 |
| Complete | High | 0,75 - 1 | 0,875 |

Source: the authors.


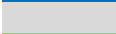



c) Questionnaire response calculation

To analyze questionnaire responses, two types of answers are distinguished: FMS criteria and FM areas. First, the mode values of the group interviewed, obtained from the 71 responses of questionnaire A, related to the evidence of the FMS criteria, are presented. Additionally, the differences between the mode values in individual responses and those grouped by macroprocess areas are analyzed. Subsequently, the mode values of the 7 multiple responses of questionnaire B, corresponding to the FM areas, are presented, highlighting the unitary responses with moderate scores) that are repeated most frequently among the interviewees in each FM area and in each FMS criterion. Finally, the mode of the results for each macroprocess area is shown, identifying the moderate score that appears most frequently among the results obtained in each of these areas and the FMS criteria.

d) Global results representation

To represent the overall result of the FMS diagnosis, considering the mode values of the FMS criteria and the FM areas previously mentioned, it is necessary to adapt the FM maturity scale (17) to the scoring used. Both the partial and total results are within an interval ranging from 0 to 1. The total assessment, designated as Z, is divided into 5 steps within this interval, as shown in Table 3. Each of these steps is assigned a color, a designation of the proposed scale, and a scoring range.

Table 3. Scoring assignment associated with the FM maturity scale

| Colour | Scale | Range Z |
|---|-----------|-------------|
|  | Optimized | 0,80 - 1 |
|  | Measured | 0,60 - 0,80 |
|  | Defined | 0,40 - 0,60 |
|  | Managed | 0,20 - 0,40 |
|  | Initial | 0 - 0,20 |

Source: the authors.

e) Weighted interview results

Finally, the absolute result of the FMS establishment diagnosis is calculated through its classification in the maturity scale, using a value called Z. This absolute result is obtained by summing the partial results of the HLS of the FMS criteria, derived from the partial results of questionnaire A criteria), into a global value called X, and summing the partial results of questionnaire B FM areas) into a global value called Y. The calculation of Z corresponds to the average of the X and Y values, as presented in the following equations. To obtain the Z value, a final score in a conservative scenario was chosen, both for the FMS criteria and for the FM areas, to obtain more representative values. First, the calculation of the X value was performed by averaging the mode results of each of the FMS criteria, minus the dispersion associated with them. That is, it was the average of the conservative absolute score. Similarly, the calculation of the Y value was performed by averaging the mode results of the FM areas, minus the dispersion associated with them, which also represents the average of the conservative absolute score, as shown in the following equations.

$$X = \frac{\Sigma \text{Moda (C, L, S, P, O, E, M)} - \Sigma \text{Desv C, L, S, P, O, E, M)}}{7}$$
$$Y = \frac{\Sigma \text{Moda (WM, RPM, CPM, FSM, ESM, MAM)} - \Sigma \text{Desv (WM, RPM, CPM, FSM, ESM, MAM)}}{6}$$
$$Z = \frac{X + Y}{2}$$

However, it is important to note that the number obtained is not weighted, since the maximum score on the average of the FMS criteria cannot exceed 0.9, and the maximum score on the average of the FM areas cannot exceed 0.875. To obtain a weighted Z value, it is necessary to consider that the maximum unweighted value is 0.888. Therefore, to calculate the Z' value, the obtained value must be multiplied by 0.888, thus achieving a maximum score of 1 in the third column associated with the FM maturity scale. The Z' value is presented more clearly in the following equation:

$$Z' = \frac{X + Y}{2} * 0,888$$

f) Identification of gaps in FMS criteria and FM areas

This gap analysis in both questionnaires is used to assess the differences between the organization's current performance and the expected performance. In this context, the term "gap" refers to the

distance between the current situation and the desired situation, which generally corresponds to operational excellence with the highest score.

In this diagnosis, the mode result of each of the 71 questions on the FMS criteria is presented, as shown in Table 1. However, to identify gaps in the FMS to seek operational excellence in health institutions (18), the mode values were also calculated for both the unitary dispersion among interviewees and the dispersion across macroprocess areas. To obtain the total dispersion for each question, an average was taken between the unitary deviation and the dispersion of the macroprocess areas. The total dispersion is classified into four color-coded categories, which reflect the following gaps in the evidence of FMS implementation:

- **Green:** Low gap with dispersion below 0.10.
- **Yellow:** Medium gap with dispersion between 0.10 and 0.20.
- **Orange:** High gap with dispersion between 0.20 and 0.30.
- **Violet:** Very high gap with dispersion above 0.30.

Additionally, a new perspective on the maturity level of FMS at CUB is presented, focusing on internal differences among FM areas for each criterion. For this purpose, a matrix was configured to display unitary dispersion among interviewees, as well as dispersion across macroprocess areas for each FMS criterion and FM area. The magnitude of dispersion is represented through the average between unitary dispersion and dispersion by areas, classified by colors as previously indicated.

g) FMS environment in the hospital

This section presents the results of Questionnaire C through a descriptive analysis of the interviewees' responses. The results detail participants' knowledge regarding healthcare quality certifications, FM, FMS, MS, and the barriers to implementing these systems in the hospital.

Results and discusión

The presentation of the results of this study, obtained from in-person and virtual interviews with CUB employees, is organized as follows:

a) Calculation of questionnaire responses

Table 4 presents the responses with moderate scores as specified in Table 1), showing the mode values among the interviewees, as well as among the macro-process areas. The values shown in this table are highlighted with colors for easy identification. It is observed that 95% of the results of the 71 questions in questionnaire A, related to FMS evidences, obtain a high or very high rating, represented in green and blue. Among these results, it is worth noting that only three evidences 34, 43 and 70) present a low score, indicated in yellow, compared to the modal value very high) of the different macro-process areas of the CUB.

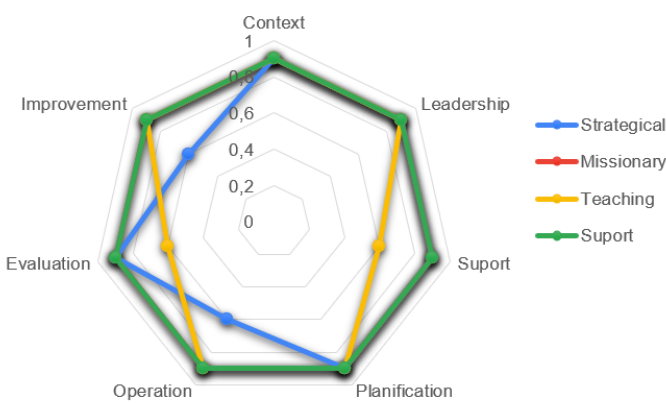
Table 4. Unitary modal and modal response of macroprocess areas in HLS of FMS questions

| | Unitary Mode | Areas Mode | | Unitary Mode | Areas Mode | | Unitary Mode | Areas Mode |
|----|-----------------|---------------|----|-----------------|---------------|----|-----------------|---------------|
| 1 | 0,9 | 0,9 | 25 | 0,6 | 0,6 | 49 | 0,9 | 0,9 |
| 2 | 0,9 | 0,6 | 26 | 0,6 | 0,6 | 50 | 0,9 | 0,9 |
| 3 | 0,9 | 0,9 | 27 | 0,9 | 0,6 | 51 | 0,9 | 0,6 |
| 4 | 0,9 | 0,9 | 28 | 0,9 | 0,9 | 52 | 0,9 | 0,9 |
| 5 | 0,6 | 0,6 | 29 | 0,9 | 0,9 | 53 | 0,9 | 0,6 |
| 6 | 0,9 | 0,9 | 30 | 0,9 | 0,9 | 54 | 0,6 | 0,6 |
| 7 | 0,9 | 0,9 | 31 | 0,9 | 0,6 | 55 | 0,6 | 0,6 |
| 8 | 0,9 | 0,9 | 32 | 0,9 | 0,9 | 56 | 0,9 | 0,6 |
| 9 | 0,9 | 0,9 | 33 | 0,9 | 0,6 | 57 | 0,9 | 0,9 |
| 10 | 0,9 | 0,6 | 34 | 0,9 | 0,2 | 58 | 0,9 | 0,9 |
| 11 | 0,9 | 0,9 | 35 | 0,9 | 0,9 | 59 | 0,9 | 0,6 |
| 12 | 0,9 | 0,9 | 36 | 0,9 | 0,9 | 60 | 0,9 | 0,6 |
| 13 | 0,6 | 0,6 | 37 | 0,9 | 0,9 | 61 | 0,9 | 0,6 |
| 14 | 0,9 | 0,9 | 38 | 0,9 | 0,6 | 62 | 0,9 | 0,9 |
| 15 | 0,9 | 0,9 | 39 | 0,6 | 0,6 | 63 | 0,9 | 0,6 |
| 16 | 0,9 | 0,9 | 40 | 0,9 | 0,9 | 64 | 0,9 | 0,6 |
| 17 | 0,9 | 0,9 | 41 | 0,6 | 0,6 | 65 | 0,9 | 0,9 |
| 18 | 0,9 | 0,6 | 42 | 0,9 | 0,9 | 66 | 0,9 | 0,9 |
| 19 | 0,6 | 0,6 | 43 | 0,9 | 0,2 | 67 | 0,6 | 0,6 |
| 20 | 0,6 | 0,6 | 44 | 0,9 | 0,6 | 68 | 0,6 | 0,6 |
| 21 | 0,9 | 0,9 | 45 | 0,9 | 0,6 | 69 | 0,9 | 0,6 |
| 22 | 0,9 | 0,9 | 46 | 0,9 | 0,6 | 70 | 0,9 | 0,2 |
| 23 | 0,9 | 0,6 | 47 | 0,9 | 0,9 | 71 | 0,9 | 0,9 |
| 24 | 0,9 | 0,9 | 48 | 0,6 | 0,6 | | | |

Source: the authors

The representation of the results of the different FMS criteria is shown in Figure 1, using a heptagonal radar chart 7 criteria), which presents four lines of results associated with the macro-process areas Strategic, Missional, Teaching, and Support). The scores are in a range of 0 to 1, according to the rating indicated in the fourth column of Table 1.

Figure 1. Modal responses in the FMS criteria according to the macroprocess areas

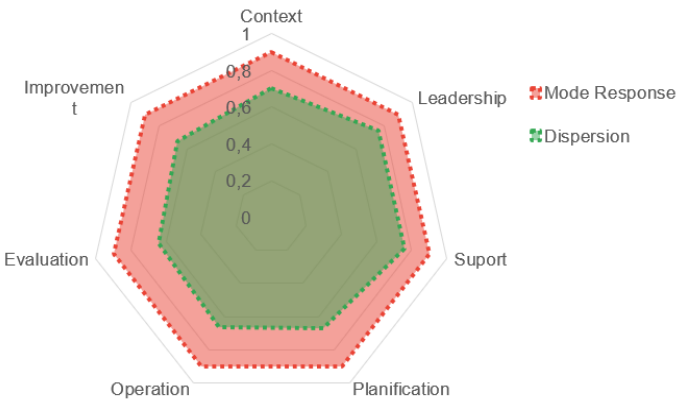


Source: the authors

In the mode values represented in Figure 1, it is observed that in the criteria of Organizational Context, Leadership, and Planning, there are no differences between the macro-process areas, compared to the other four criteria Support, Operation, Performance Evaluation, and Improvement) which do show differences. However, the representation of the total responses through the mode results in each of the 7 FMS criteria, along with the mode of the dispersion, is reflected in Figure 2. In this figure, the maximum modal result of all FMS criteria is shown in pink, while the modal result of the FMS criteria, minus its dispersion, is presented in green. Thus, the

range between the maximum results mode) and their dispersion standard deviation) represents the influence zone of the results of the HLS of FMS criteria.

Figure 2. Modal responses and the dispersion between FMS criteria



Source: the authors

The location of the results in this zone indicates that the narrower the range in each of the criterion, the smaller the difference in responses between interviewees. That is, as this influence zone decreases, the responses issued by interviewees tend to be more similar. In this case, it is observed that the influence zone has a medium-high range, between 0,14 and 0,26. This suggests that, in this context, it is somewhat more complex to guide CUB’s FMS agents towards the new objectives established to reduce gaps.

On the other hand, when analyzing the scoring of the responses both unitary and area) in Table 5, it can be noted that more than 65% of the results are represented in yellow, which indicates an average rating. 35% of the results, however, are shown in green third column of Table 2), which indicates a high rating on the main FM areas in the respective FMS criteria. These main FM areas are: Workplace Management WM), Real Estate & Property Management RPM), Corporate Project Management CPM), Facilities Services Management FSM), Energy & Sustainability Management ESM), and Maintenance & Asset Management MAM).

Table 5. Unitary and modal response of macroprocess areas in questions from the FM areas

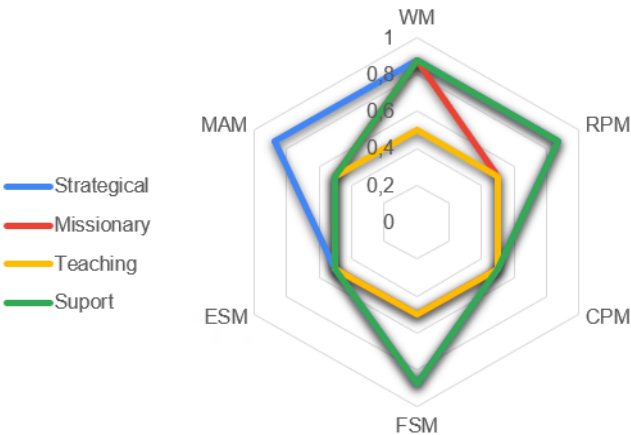
| FMS CRITERIA | Assessment | WM | RPM | CPM | FSM | ESM | MAM |
|---------------|--------------|-------|-------|-------|-------|-------|-------|
| Organization | Unitary Mode | 0,500 | 0,875 | 0,500 | 0,875 | 0,500 | 0,875 |
| | Areas Mode | 0,500 | 0,500 | 0,500 | 0,500 | 0,500 | 0,875 |
| Context | Unitary Mode | 0,875 | 0,875 | 0,500 | 0,875 | 0,500 | 0,875 |
| | Areas Mode | 0,875 | 0,500 | 0,500 | 0,875 | 0,500 | 0,500 |
| Leadership | Unitary Mode | 0,875 | 0,875 | 0,500 | 0,875 | 0,500 | 0,500 |
| | Areas Mode | 0,875 | 0,500 | 0,500 | 0,500 | 0,500 | 0,500 |
| Support | Unitary Mode | 0,875 | 0,875 | 0,500 | 0,875 | 0,500 | 0,875 |
| | Areas Mode | 0,875 | 0,500 | 0,500 | 0,500 | 0,500 | 0,500 |
| Planification | Unitary Mode | 0,875 | 0,500 | 0,500 | 0,875 | 0,500 | 0,875 |
| | Areas Mode | 0,875 | 0,500 | 0,500 | 0,500 | 0,500 | 0,500 |
| Operation | Unitary Mode | 0,875 | 0,500 | 0,500 | 0,875 | 0,500 | 0,875 |
| | Areas Mode | 0,500 | 0,500 | 0,500 | 0,500 | 0,500 | 0,500 |
| Performance | Unitary Mode | 0,875 | 0,875 | 0,500 | 0,875 | 0,500 | 0,500 |
| | Areas Mode | 0,875 | 0,500 | 0,500 | 0,500 | 0,500 | 0,500 |
| Evaluation | Unitary Mode | 0,875 | 0,875 | 0,500 | 0,500 | 0,500 | 0,500 |
| | Areas Mode | 0,500 | 0,500 | 0,500 | 0,500 | 0,500 | 0,500 |

Source: the authors.

The results show that the CPM and ESM areas have a unanimous average rating across all FMS criteria, with no differences in the responses of CUB interviewees. In contrast, the WM, RPM, FSM, and MAM areas present variations in their modal values, either in the unitary mode, in the mode by macro-process areas, or in both, indicating discrepancies in the responses.

The data is represented in a hexagonal radar chart Figure 3), where the strategic area blue) obtains the highest score, the missional and support areas show irregular values, and the teaching area yellow) registers the lowest. This indicates a greater dispersion in certain macro-process areas compared to the overall results of the 14 interviewees. Nevertheless, CPM and ESM maintain uniformity, as detailed in Table 5.

Figure 3. Modal responses of the FM areas according to the macroprocess areas

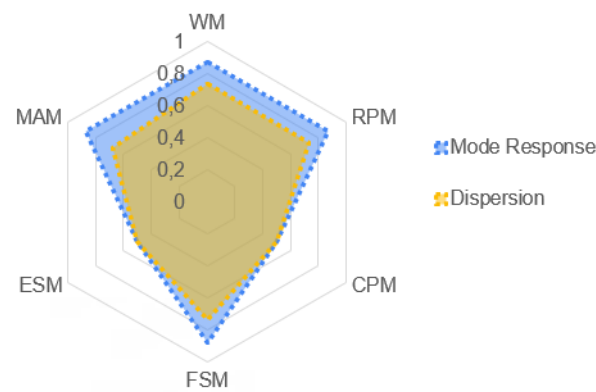


Source: the authors

In Figure 4, the mode values in each FM area are represented in blue, while the mode of the dispersion between the two appears in yellow. The image shows an influence zone between the

maximum mode values and the mode values of their dispersion standard deviation) in each FM area, following the same procedure described in the previous section. In this case, the influence zone in the FM areas within the FMS is of medium-low type, since it is in a range of 0 to 0.18, which indicates a value slightly lower than that shown in Figure 2 for the FMS criteria.

Figure 4. Modal responses and dispersion between FM areas



Source: the authors

Furthermore, the results of the FM areas on CPM and ESM show a null influence zone, as no dispersion is observed in the responses of the interviewees. This suggests that, in the absence of significant differences in perceptions, it will be less complex to guide the FMS agents of an institution to reduce existing discrepancies, given that most interviewees share a similar vision in those FM areas.

b) Representation of global results

On one hand, the results obtained from the modal response of each FMS criterion and the mode of its dispersion, previously presented, are shown in Table 6. For this analysis, a conservative approach was adopted in the final scoring of each FM criterion, opting for a value lower than that indicated by the mode first row of Table 6). In this case, the final score in a conservative scenario is calculated by subtracting the dispersion result from the mode value in each FMS criteria. In some cases, the dispersion corresponds directly to the mode most repeated term), while in others, the average of the dispersion is used when all terms differ from each other.

Table 6. Score for the overall result of the FMS criteria

| FMS Criteria | C | L | P | S | O | E | M |
|-----------------------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| Result of the Mode Criteria | 0,9 | 0,9 | 0,9 | 0,9 | 0,9 | 0,9 | 0,9 |
| Result of the Dispersion Criteria | 0,195 | 0,141 | 0,141 | 0,229 | 0,238 | 0,257 | 0,236 |
| Final Score Conservative Esc.) | 0,705 | 0,759 | 0,759 | 0,671 | 0,662 | 0,643 | 0,664 |

Source: the authors

On the other hand, Table 7 presents the mode results of the FM areas in each FMS criteria, as well as their dispersion, previously presented. In addition, it includes the data mentioned above and the final score in a conservative scenario, calculated using the same procedure described in the previous paragraph.

Table 7. Score for the overall result of the FM areas

| FM Areas | WM | RPM | CPM | FSM | ESM | MAM |
|-----------------------------------|-------|-------|-------|-------|-------|-------|
| Result of the Mode FM Areas | 0,875 | 0,875 | 0,5 | 0,875 | 0,5 | 0,875 |
| Result of the Dispersion FM Areas | 0,142 | 0,142 | 0 | 0,142 | 0 | 0,183 |
| Final Score Conservative Esc.) | 0,733 | 0,733 | 0,500 | 0,733 | 0,500 | 0,692 |

Source: the authors

c) Weighted results of the interviews

The weighted Z' value of the interviews for this case study was 0.76. According to the FM maturity scale (17), this result corresponds to the “MEASURED” level, being in the range (0,60-0,80) of Table 3. This indicates that the maturity status of the FM activities, within the FMS of this organization, meets most of the requirements, has documentation for the most part and allows stakeholders to access part of this information.

d) Identification of gaps in the FMS and the FM areas

To identify gaps in the FMS, the mode values were calculated for the unitary dispersion of the respondents and for the macroprocess areas. These results allow us to distinguish two types of gaps: in the FMS criteria and in the FM areas. For gaps in the FMS criteria, the unitary deviation and the dispersion of the macroprocess areas were averaged. Table 8 shows the total dispersion, classified into four colors violet, orange, yellow, and green) according to the magnitude of the gaps in the establishment of the FMS.

Tabla 8. Dispersión individual de las preguntas de los criterios del FMS

| | Unitary | Areas | | Unitary | Areas | | Unitary | Areas |
|----|---------|-------|----|---------|-------|----|---------|-------|
| 1 | 0,206 | 0,173 | 25 | 0,141 | 0,150 | 49 | 0,206 | 0,000 |
| 2 | 0,154 | 0,000 | 26 | 0,154 | 0,000 | 50 | 0,211 | 0,000 |
| 3 | 0,128 | 0,150 | 27 | 0,255 | 0,173 | 51 | 0,149 | 0,173 |
| 4 | 0,141 | 0,377 | 28 | 0,141 | 0,000 | 52 | 0,212 | 0,332 |
| 5 | 0,308 | 0,150 | 29 | 0,212 | 0,150 | 53 | 0,156 | 0,173 |
| 6 | 0,149 | 0,150 | 30 | 0,149 | 0,150 | 54 | 0,201 | 0,173 |
| 7 | 0,214 | 0,350 | 31 | 0,246 | 0,173 | 55 | 0,279 | 0,173 |
| 8 | 0,259 | 0,000 | 32 | 0,206 | 0,000 | 56 | 0,156 | 0,173 |
| 9 | 0,109 | 0,000 | 33 | 0,149 | 0,173 | 57 | 0,257 | 0,332 |
| 10 | 0,156 | 0,173 | 34 | 0,246 | 0,340 | 58 | 0,257 | 0,332 |
| 11 | 0,080 | 0,000 | 35 | 0,128 | 0,150 | 59 | 0,212 | 0,287 |
| 12 | 0,141 | 0,150 | 36 | 0,259 | 0,350 | 60 | 0,213 | 0,350 |
| 13 | 0,213 | 0,150 | 37 | 0,206 | 0,000 | 61 | 0,212 | 0,173 |
| 14 | 0,141 | 0,150 | 38 | 0,212 | 0,173 | 62 | 0,327 | 0,450 |
| 15 | 0,149 | 0,150 | 39 | 0,241 | 0,150 | 63 | 0,246 | 0,287 |
| 16 | 0,141 | 0,000 | 40 | 0,253 | 0,300 | 64 | 0,212 | 0,173 |
| 17 | 0,080 | 0,000 | 41 | 0,282 | 0,300 | 65 | 0,149 | 0,150 |
| 18 | 0,156 | 0,150 | 42 | 0,256 | 0,150 | 66 | 0,141 | 0,150 |
| 19 | 0,238 | 0,287 | 43 | 0,286 | 0,403 | 67 | 0,279 | 0,287 |
| 20 | 0,186 | 0,300 | 44 | 0,156 | 0,173 | 68 | 0,208 | 0,200 |
| 21 | 0,141 | 0,150 | 45 | 0,253 | 0,173 | 69 | 0,253 | 0,173 |
| 22 | 0,128 | 0,000 | 46 | 0,154 | 0,173 | 70 | 0,308 | 0,200 |
| 23 | 0,154 | 0,173 | 47 | 0,253 | 0,424 | 71 | 0,313 | 0,332 |
| 24 | 0,149 | 0,150 | 48 | 0,248 | 0,173 | | | |

Source: the authors

The authors present the average modal values for each question Table 3), along with the unitary dispersion of the respondents and the dispersion between macroprocess areas Table 8), to identify gaps in the FMS criteria. Table 9 shows that the average of the results reaches the highest level of the scale OPTIMIZED). However, the variability in the deviation of these results among the respondents indicates that the gap toward operational excellence is variable. The third and fourth columns of Table 9 reflect the following gaps according to dispersion:

- Low <0.10) in “Organizational Context” and “Leadership,” which encompass strategic and transformational activities.
- Medium 0.10–0.20) in “Support” and “Planning,” which are responsible for tactical activities.
- High 0.20–0.30) in “Operations,” “Performance Evaluation,” and “Improvement,” which correspond to operational activities.

Table 9. Summary of mode values calculated from the FMS criteria.

| FMS Criteria | Average of Modal Values | Average Unit Dispersion | Average Dispersion between Areas |
|------------------------|-------------------------|-------------------------|----------------------------------|
| Organization Context | 0,862 | 0,195 | 0,000 |
| Leadership | 0,862 | 0,141 | 0,000 |
| Support | 0,836 | 0,141 | 0,150 |
| Planification | 0,825 | 0,229 | 0,000 |
| Operation | 0,833 | 0,253 | 0,173 |
| Performance Evaluation | 0,862 | 0,257 | 0,150 |
| Improvement | 0,814 | 0,236 | 0,173 |

Source: the authors

Table 9 shows that the CUB’s FMS presents a reduced gap, which could allow it to achieve a higher score on the maturity scale (17) by reducing differences between agents and macro-processes. To this end, it is key that the organization identifies, communicates, and disseminates documents that evidence the state of the FMS in future diagnoses.

For its part, Table 10 presents, in the last row and column, the total dispersion differences in the FM areas and the FMS criteria, calculated from the modal value of the average between unitary dispersion and dispersion by macro-processes. A medium-high dispersion is observed in the FM areas, except in CPM and ESM, where it is lower, in line with what is shown in Figures 2 and 4, which reflect homogeneous responses in these areas. Regarding the FMS criteria within the FM in this organization, the dispersion is medium-high, except in “Organizational Context,” where it is low-medium.

Using the mode values and dispersions of the different macroprocesses and FM areas presented in Tables 4 to 10, the following gaps were identified:

WM Area: This is the only area with a high rating in the mode values of FMS criteria and a medium dispersion. In contrast, the remaining FM areas exhibit medium ratings and dispersions. This indicates a low gap in WM and a medium gap in the other areas, particularly in CPM and ESM, which have the lowest values.

FMS Criteria in FM: All criteria show a medium rating in both mode values and dispersion, indicating a medium gap. CUB must improve FM activities in several areas to reduce this gap.

Table 10. Dispersion of results in the FM areas according to the FMS criteria.

| FMS Criteria | Dispersion | WM | RPM | CPM | FSM | ESM | MAM | Total |
|--------------------------|--------------------|---------------|-------------|-------------------|-------------|------------|----------------------|--------------------|
| Organization | Unitary Dispersión | 0,160 | 0,193 | 0,136 | 0,193 | 0,186 | 0,186 | Low-Medium |
| | Areas Dispersión | 0,000 | 0,188 | 0,000 | 0,217 | 0,000 | 0,188 | |
| Context | Unitary Dispersión | 0,136 | 0,186 | 0,201 | 0,176 | 0,186 | 0,193 | Medium |
| | Areas Dispersión | 0,188 | 0,217 | 0,000 | 0,188 | 0,000 | 0,217 | |
| Leadership | Unitary Dispersión | 0,193 | 0,186 | 0,160 | 0,195 | 0,186 | 0,193 | Mediua |
| | Areas Dispersión | 0,188 | 0,217 | 0,000 | 0,217 | 0,000 | 0,188 | |
| Support | Unitary Dispersión | 0,193 | 0,176 | 0,178 | 0,193 | 0,193 | 0,193 | Medium-High |
| | Areas Dispersión | 0,217 | 0,217 | 0,188 | 0,217 | 0,188 | 0,217 | |
| Planification | Unitary Dispersión | 0,193 | 0,195 | 0,227 | 0,186 | 0,160 | 0,193 | High |
| | Areas Dispersión | 0,217 | 0,188 | 0,188 | 0,217 | 0,000 | 0,217 | |
| Operation | Unitary Dispersión | 0,136 | 0,186 | 0,176 | 0,186 | 0,186 | 0,193 | Medium |
| | Areas Dispersión | 0,188 | 0,217 | 0,000 | 0,217 | 0,000 | 0,000 | |
| Performance | Unitary Dispersión | 0,176 | 0,193 | 0,223 | 0,176 | 0,239 | 0,193 | Medium |
| | Areas Dispersión | 0,217 | 0,217 | 0,000 | 0,188 | 0,000 | 0,188 | |
| Evaluation | Unitary Dispersión | 0,176 | 0,193 | 0,223 | 0,176 | 0,239 | 0,193 | Medium |
| | Areas Dispersión | 0,217 | 0,217 | 0,000 | 0,188 | 0,000 | 0,188 | |
| Improvement | Unitary Dispersión | 0,176 | 0,193 | 0,223 | 0,176 | 0,239 | 0,193 | Medium |
| | Areas Dispersión | 0,217 | 0,217 | 0,000 | 0,188 | 0,000 | 0,188 | |
| Total Differences | | Medium | High | Low-Medium | High | Low | Medium - High | |

Source: the authors

e) FMS environment in the hospital

The responses from Questionnaire C regarding the MS environment at CUB revealed that 100% of interviewees agreed with the following aspects:

- Their position is highly related to FM activities and the establishment of FMS at CUB.
- There is a willingness to implement SG to improve both care and support processes.
- CUB has adopted quality systems or process improvement initiatives related to FM.
- The current SG evaluates quality, environmental impact, occupational health and safety, risk management, information security, and support activities.
- They are familiar with methods for measuring these factors and their contribution to improving non-core activities.
- CUB uses performance indicators reviewed by senior management for continuous improvement.
- It holds at least two recognized credentials: National Health Accreditation and University Hospital status.
- A high level of compliance with organizational objectives is perceived in non-core areas FM).

Most interviewees agreed on the following points from Questionnaire C, conducted after the interview:

- 89% indicated that CUB is interested in obtaining certification from The Joint Commission International (JCI).
- Regarding knowledge of other SG related to support activities:
- 66% recognize ISO 9001 quality) and ISO 31001 risk management).
- 55% are familiar with ISO 14001 environmental management) and ISO 45001 occupational health and safety).
- 22% identify ISO 55001 asset management).
- No interviewee knows whether CUB holds any SG certifications.
- 89% stated that CUB has a document identifying core and non-core activities, along with roles and responsibilities. However, there is no consensus on its identification, although some responses mentioned the Andrómeda information SG developed by CUB.
- 88% confirmed that CUB measures the satisfaction of healthcare users and medical staff regarding non-core areas FM).
- 77% recognized that stakeholder satisfaction with non-core areas FM) is evaluated.
- 88% perceived high satisfaction among FS internal or outsourced) regarding their functions within CUB. However, opinions were divided on the FM strategy:
- 55% considered it hybrid a mix of in-house and outsourced staff).
- 45% perceived it as fully outsourced, as most staff are external.

The interviewees identified the following impediments and their significance:

- 88% considered the cost-benefit ratio highly relevant.
- 66% viewed resistance to change as minimally relevant.
- 66% believed lack of time was highly relevant.
- 66% indicated that lack of management commitment was not relevant.
- 55% stated that lack of staff participation was highly relevant, although opinions were divided.
- 50% considered excessive documentation highly relevant, as it could create bureaucracy, though opinions were not unanimous.
- 50% believed that lack of training was minimally relevant, though responses were divided.

Besides, the hospital staff interviewed shared the following observations:

- The informational session on FM and MS was extensive but clear and relevant to their roles. Additionally, they expressed interest in how the future "SIFMCol Model" relates to SUH, SUA, and JCI standards.
- They considered it crucial to understand the synergies and conflicts in support activities based on the compatibility between ISO standards (UNE, 2018) and hospital accreditations.
- They highlighted the need to unify the language between healthcare quality standards (SUA, SUH, and JCI) and ISO standards, as well as to explore the interaction of an Integrated FM System (IFMS) with macroprocess areas.
- They emphasized that identifying gaps in an IFMS would provide a clear view of CUB's needs and a range of improvements for support activities in healthcare.
- Regarding the implementation of the "SIFMCol Model", they pointed out the importance of

identifying synergies between FMS processes and systematizing standards to demonstrate compliance and alignment of objectives across departments.

- They mentioned that while CUB has a general MS tool, its application presents challenges. However, they see potential in an FMS that could be enriched by input from all stakeholders.

Discussion

The authors of this study identified four key perspectives in the diagnosis of the FMS at CUB: the global vision of the FMS, the evaluation of its evidence, the analysis of FM areas in each criterion, and the impact of the institutional environment on the MS.

The overall diagnostic score Z' is 0,76, classifying CUB's FMS as "MEASURED", though it is close to being "OPTIMIZED". This indicates that the organization meets most of the requirements, which are documented and accessible to stakeholders. However, gaps were identified in four of the seven criteria of the HLS of FMS Support, Operation, Performance Evaluation, and Improvement), whereas the criteria for Organizational Context, Leadership, and Planning were homogeneous. Additionally, there are differences in the macroprocess areas' perspectives in four out of six FM areas (FSM, MAM, WM, and RPM), while ESM and CPM present a uniform vision, albeit with lower results. The dispersion of results varies among FMS areas, with medium-low standard deviations, except in ESM and CPM, where they are homogeneous. Furthermore, the authors of this work understand that the identification of gaps will allow strengthening the communication channels through the implementation of solid feedback mechanisms and promoting greater transparency in problem resolution would support the development of a more responsive and responsible management framework (19).

The results from the 71 questions on FMS evidence show that more than 50% received a very high score (0,9), while only 5% had a low score (0,2). Five questions (6%) were identified with very high dispersion, and 24 questions (34%) with high dispersion, meaning that 60% of the responses show low or very low dispersion. Questions with low scores also exhibit high dispersion, indicating a significant gap in achieving operational excellence. The mode values of the 7 questions regarding the 6 FM areas indicate that only 14% achieved a high score (0,9), while 5% scored low (0,2). Regarding dispersion, 25% of the areas exhibited low gaps, 40% medium gaps, and 25% high gaps. This suggests that more than 75% of FM areas show medium-high dispersion, according to the perception of the interviewees (20).

All of the interviewees agreed that their positions are related to FM activities and the establishment of an FMS in the organization. CUB is willing to implement various MS to improve both healthcare and support processes, enabling it to achieve national health accreditation and university hospital certification. Additionally, 89% of interviewees stated that CUB aims to obtain JCI accreditation. Although they are familiar with SG and its performance indicators, most are unfamiliar with the ISO's MS related to support activities, which may explain the lack of interest in them. However, they confirm that CUB has documents identifying core and non-core activities, as well as roles and responsibilities, compiled in its information MS, called Andrómeda.

The authors of this study observe that most participants in the diagnosis recognize that CUB conducts satisfaction assessments for users, medical staff physicians and nurses), and stakeholders regarding non-core FM) areas within the institution. The satisfaction level regarding employee expectations of the performance of FS functions, whether internal or outsourced, is quite high (21). However, interviewees hold divided or unclear opinions on whether the contracting strategy for these companies is hybrid (a mix of in-house and outsourced personnel) or fully outsourced, where most staff are external to CUB.

Finally, according to most interviewees, the main barriers or obstacles to establishing MS at CUB include the creation of a more bureaucratic structure, lack of time, and staff participation in MS. The remaining four factors (22) were considered less relevant in the establishment of MS in this institution.

Conclusion

The FMS diagnosis at CUB, conducted using the "DiagSFMHosp v2.0" tool with questionnaires A and B, indicates a maturity level classified as "MEASURED", very close to achieving operational excellence. This suggests that the organization meets most of the FMS requirements, the interviewees can identify the associated documentation or evidence, and that most of this information is accessible.

However, gaps were identified in four out of the seven evaluated criteria, specifically in Support, Operation, Performance Evaluation, and Improvement, whereas Organizational Context, Leadership, and Planning exhibited greater homogeneity. Regarding the FM areas, WM, RPM, FSM, and MAM achieved higher scores, although their responses showed variability, indicating perceptual gaps among interviewees. In contrast, CPM and ESM showed greater uniformity in their assessments, albeit with lower scores.

The results of questionnaire C reveal that all interviewees consider their roles within the institution to be related to FM and FMS activities. Additionally, the majority recognize the importance of implementing MS to enhance both healthcare and support processes. However, a widespread lack of knowledge regarding ISO certifications in support activities was identified, which could hinder the integration of these standards with the achievement of healthcare accreditations, such as the JCI.

Finally, the authors of this study agree that the results of this FMS diagnosis at CUB are closely related to the credentials held by this healthcare institution, including SUH, SUA, University Hospital status, and recognition as one of the 30 best clinics in Latin America. Nevertheless, addressing the identified deficiencies and improving the efficiency of the FMS is crucial to strengthening communication, documentation, and process standardization within this institution and should be the focus of another study.

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