Towards an Agile-Based Integrated Management Systems Framework

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ABSTRACT

Purpose: We propose an unprecedented model for incorporating agile methodology (AM) into the development of an Integrated Management System (IMS).

Design/Methodology: The research design employed a literature review and content analysis approach. We identified ten distinct IMS models from academic literature and subjected them to critical cross-analysis. Additionally, we conducted an exhaustive review of seminal agile literature to pinpoint essential characteristics of both AM and IMS.

Findings: The comprehensive content analysis and coding process facilitated identifying fundamental agile elements to be integrated into the proposed framework. As a result, we present an interdisciplinary Agile-based Integrated Management System (AIMS) framework.

Originality: This framework draws upon insights from diverse research sources and introduces a three-level analysis perspective: strategic, tactical, and operational. Integrating IMS with AM empowers organisations to make more agile and responsive decisions concerning IMS implementation. Within this framework, the IMS backlog is defined concurrently with its development, reflecting an adaptive approach in contrast to the conventional project scope delineation.

Category: Research paper

Keywords: integrated management system; certifiable management systems; agile methodologies

Research Areas: Quality Management and Strategic Quality Management

1 INTRODUCTION

In a competitive marketplace, organisations strive to distinguish themselves by enhancing product and service quality, minimising natural resource utilisation, ensuring employee safety, and meeting customer expectations. To improve performance, many organisations have implemented certifiable Management Systems (MSs) like ISO 9001 Quality Management System (QMS), ISO 14001 Environmental Management System (EMS), and OHSAS 18001 Occupational Health and Safety Management System (OHSMS), which succeeded by ISO 45001 in 2018 (Majerník et al., 2017; Nunhes et al., 2017). These systems boast approximately 1,792,737 certifications worldwide (ISO, 2021). However, organisations that manage these MSs separately encounter persistent challenges such as resource inefficiency, duplicated tasks, high maintenance costs, internal communication issues, and more (Muthusamy et al., 2017). The Integrated Management System, which merges these MSs into a unified system, offers a solution by effectively utilising resources, reducing bureaucracy, enhancing communication flow, and integrating company departments, resulting in streamlined processes and services (Nunhes et al., 2017). To facilitate the integration of certifiable MSs, ISO introduced Annex SL in 2012, providing a common structure, terminology, and requirements for developing and updating these management standards (Majerník et al., 2017; Nunhes et al., 2017; Nunhes et al., 2021).

Some scientific studies proposed guidelines, systems, models, and methods to integrate these MSs in a traditional way. Mackau (2003) presents an IMS handbook for SMEs; Zeng et al. (2007) proposed a synergetic IMS model; Zgodavova and Bober (2012) proposed an IMS model, followed by a simulation of its implementation in the SIMPRO Software. Oliveira (2013) proposed guidelines to IMS in industrial companies; Bekčić et al. (2013) proposed an IMS sun model; Rebelo et al. (2014) and El Yacoubi et al. (2014) proposed a generic model for IMS; Majerník et al. (2017) proposed an algorithm to IMS based on Annex SL; Muthusamy et al. (2018) proposed a model with a holistic approach for IMS; and Ahidar et al. (2019) propose an approach to IMS using SYSML language. Domingues et al. (2015) highlighted the opportunity to create a new IMS development proposal that gathered the strengths of the main existing proposals in the literature, which was realised in this work. In addition, elements of the Agile methodology were added to this new model to make it more flexible and agile. An IMS development project can be managed according to a Project Management (PM) plan to promote more efficiency in its development, minimising failures, reducing rework, increasing stakeholder satisfaction, ensuring greater control of processes, and enhancing decision-making agility. PM is an important tool for optimised IMS project management that makes it possible to translate corporate policies, objectives, and strategies into project procedures (Azanha et al., 2017; Hendler, 2020; Marnewick and Marnewick, 2022).

Over the past decades, Agile Methodologies emerged as a fitting approach for dynamic environments (Conforto et al., 2016), transcending the software

development sector and scaling for larger organisations (Marnewick and Marnewick, 2022). Scaling AM in innovative projects like IMS can boost efficiency, flexibility, and agility (Azanha et al., 2017; Hendler, 2020; Tam et al., 2020), facilitating the sharing of a vision in a dynamic environment and enhancing the flexibility of mature organisations (Santos and Carvalho, 2021). Numerous AM types are found in the literature, with Extreme Programming, Feature Driven Development, Dynamic Software Development Methods, Crystal Methods, and Scrum being prominent examples (Morandini et al., 2021). Initially developed for software development (Hidalgo, 2019; Morandini et al., 2021), Agile has proven its adaptability to diverse organisations aiming to implement PM processes more flexibly (Burga et al., 2022; Malik et al., 2021). Agile's versatility extends to projects with specific or complex requirements, breaking down processes into manageable tasks within predefined cycles, ultimately enhancing understanding, risk reduction, and overall efficiency (Burga et al., 2022; Hidalgo, 2019). Both IMS and AM are rooted in the PDCA cycle from Toyota's productive methods in the 1950s, proposing continuous improvement through evolutionary cycles, elevating team productivity and project quality and speed. The introduction of AM to swiftly adapt to changes in projects while maintaining or surpassing customer service levels, bringing speed and flexibility (Burga et al., 2022; Marnewick and Marnewick, 2022).

Some authors have studied the relationship between AM and QMS ISO 9001, but there are no relevant studies on the AM relationship with other certifiable standards, such as ISO 14001 and ISO 45001, or with these integrated standards in the literature consulted (Hidalgo, 2019; Nunhes et al., 2017). While some researchers explored the relationship between AM and QMS ISO 9001, there is a scarcity of studies examining the connection between AM and other certifiable standards like ISO 14001 and ISO 45001, or their integrated standards, in the consulted literature (Hidalgo, 2019; Nunhes et al., 2021). Stålhane and Hanssen (2008) analysed how to align agile development with the speed and lean development of ISO 9001 processes, minimising documentation and enhancing quality process control. Silva et al. (2020) analysed the importance of integrating the environment into Lean Philosophy. Popović (2015) suggested that Scrum methodology can enhance flexibility in QMS processes, aiding organisations in successfully obtaining ISO 9001 certification. Gallardo-Cueva et al. (2020) proposed a theoretical model to enhance product and service quality using AM to support the selection of suitable QMS models for the software industry.

Our research extends these studies by not only exploring the use of AM for improving QMSs but also investigating its relationships with other MSs and their integration. We propose a framework containing an unprecedented model for incorporating agile methodology into IMS development. These findings underscore the potential of AM in the context of IMS development, offering a promising avenue for further research and aiding managers in optimising IMS development. This work contributes significantly to knowledge by presenting a novel framework and insights that shed fresh light on this research gap. In light of

the foregoing, the aim of this work is to propose an unprecedented and robust framework with a model for incorporating elements of the agile methodology into the Integrated Management Systems development process. This study addresses a research gap concerning the utilisation of AM to enhance the flexibility, agility, and customisation of IMS development (Hidalgo, 2019; Morandini et al., 2021). Consequently, this research seeks to answer the following question:

How can IMS development be enhanced through the application of agile methodologies?

To answer the research approach is a literature review bridging IMS and AM, aiming at developing an Agile-based IMS framework. The framework contributes by optimising the IMS development process by systematically incorporating key elements from prominent proposals identified in the academic literature and integrating Agile Methodology.

After this introduction, the literature review is presented in section 2, the research method used in this work is presented in section 3, and the proposed model and the discussions of the results are presented in sections 4 and 5, respectively. Finally, section 6 presents the conclusion of the paper, followed by the references.

2 LITERATURE REVIEW

2.1 Integrated management system

The MSs standards ISO 9001, ISO 14001, and ISO 45001 have a similar structure of principles, objectives, and requirements. All of them require the formulation of policies and objectives, the definition of roles and responsibilities, the training of employees, etc. (Santos and Millán, 2013; Fonseca and Domingues, 2018; Doiro et al., 2017; Nunhes et al., 2017; Vieira et al., 2019; Milovanović et al., 2023). Considering these similarities, the implementation of separated MSs can become inefficient, as it duplicates tasks, the number of resources used is greater in relation to a situation of integration, and the alignment with the company's strategy is difficult due to the different objectives that each standard pursues. The IMS helps then to mitigate these difficulties by integrating these management systems (Rebelo et al., 2016; Santos et al., 2017). To contribute to the IMS, ISO created the Annex SL in 2012, which is a High-Level Structure (HLS) that serves as the basis for the development of certifiable management standards, presenting usual terms, definitions, and requirements structure that help certifiable management standards to become more compatible (Majerník et al., 2017; Nunhes et al., 2017). Since 2015, the publications and revisions of certifiable management standards are based on the Annex SL. The ISO 9001 and ISO 14001 have undergone changes in their structures, and ISO 45001 has been created according to Annex SL to meet the needs that have arisen with market changes and advances and in response to organisations that needed a solution that desire integrated their MSs (Majerník et al., 2017; Nunhes et al., 2017).

The IMS has gained prominence in both academic and corporate environments (Bernardo et al., 2018). In front of competitiveness and the high demands on services and products, some organisations seek to align IMS with other themes, such as those related to sustainable innovation or business strategy. The IMS related to sustainable innovation allows for reducing costs, for example, by the conscious use of raw materials and natural resources. This relationship increases the chances of innovation in processes and products but also emphasises that organisations need to be open to criticism and suggestions from their stakeholders throughout the life cycle of their products and services (Bernardo et al., 2018; Majerník et al., 2017). The IMS related to business strategy focuses on organisational culture and takes into consideration the internal and external aspects that affect the company, assisting in adapting its MSs to the constant market changes. In this context, IMS seeks to predict how other companies will develop their strategies in the market and how this development can be exploited to gain competitive advantage (Bernardo et al., 2018; Nunhes et al., 2017).

2.2 Models for the development of IMS

Table 1 summarises ten articles dealing specifically with IMS development that served as a basis for the systematisation of the generic IMS model (section 4).

Table 1 – Models for the development of IMS

Title Paper	Author(s)(Year)	Models description
Approach to integrating management systems: Path to excellence application for the automotive sector using SYSML language	Ahidar et al., (2019)	A proposal for the implementation and/or development of the IMS through the System Modeling Language (SYSML) and the integration strategy on three organisational levels (strategic, tactical, and operational)
A comprehensive model and holistic approach for implementing an integrated management system	Muthusamy et al., (2018)	A model for implementation and/or development of the IMS is divided into four stages (awareness, cooperation, consonance, and combination) based on the PDCA Cycle and PAS 99: 2012.
Design of integrated management systems according to the revised iso standards	Majerník et al., (2017)	A model for implementation and/or development model of the IMS (consisting of seven steps) based on the PDCA cycle and the structure in Annex SL
Integrated management system: Towards a new approach and a new model	El Yacoubi et al., (2014)	A generic model for IMS implementation is divided into three circular dimensions. The first circular dimension represents resource management and indicates the means necessary for IMS. The second dimension concerns tactical operations and is based on the PDCA cycle. The third dimension consists of strategic operations.
A generic model for integration of quality, environment, and safety management systems	Rebelo et al., (2014)	The generic IMS model for quality, environment, and safety management is based on the Deming Cycle, in which each phase concerns the execution of a type of activity aimed at the development of the IMS.

Title Paper	Author(s)(Year)	Models description
Guidelines for the integration of certifiable management systems in industrial companies	Oliveira, (2013)	Guidelines for integrating MSs in industrial companies are divided into three phases (1. planning the implementation of the MS, 2. description of the elements necessary for the development of the IMS and the control and 3. continuous improvement)
Approach to the integration of management systems in a pharmaceutical organisation	Bekčić et al., (2013)	A model in the form of the Sun, in which the central part (corresponding to the Sun's core) represents the integrable elements of each MS, while the Sun's rays indicate the specific elements of each MS are managed individually.
An innovative approach to the integrated management system development: SIMPRO-IMS web-based environment	Zgodavova and Bober, (2012)	A model for implementing IMS through Integrated Management System Role Play Simulation (SIMPRO). This model helps top management to create and control the documentation needed to implement the IMS.
A synergetic model for implementing an integrated management system: an empirical study in China	Zeng et al. (2007)	A synergy model for integrating MSs at three levels. The first level is the integration of the MS strategies, the second level is the integration of the elements related to organisational structure, culture, and resources, and the third level is the integration of documentation.
SME integrated management system: A proposed experiences model	Mackau, (2003)	An IMS implementation model based on an analysis of the results of a case study in a small construction company in Germany.

The most common strategy used in the analysed proposals was the one based on hierarchical levels (strategic, tactical, and operational), which was used in 7 publications, Mackau (2003), Zeng et al. (2007), Oliveira (2013), Rebelo et al. (2014), Majerník et al. (2017), Muthusamy et al. (2018), and Ahidar et al. (2019). While the application of the PDCA cycle, which serves as a reference for ISO standards in their frameworks, was used in 8 publications, Zeng et al. (2007), Zgodavova et al. (2012), Oliveira (2013), Rebelo et al. (2014), and El Yacoubi et al. (2014), Majerník et al. (2017), Muthusamy et al. (2018), and Ahidar et al. (2019).

To align these three hierarchical levels, two types of meetings are recommended: level-exclusive and integrated. In meetings exclusive to each level, the information covered is focused on each area of activity, with specific objectives and goals. In the integrated meeting, the information covered is focused on more systemic objectives and goals aligned with the organisation's strategy, mission, and vision. The generic IMS systematised model emphasises the alignment of the IMS with stakeholders' needs and expectations. Customers, partners, suppliers, and the community are considered key elements that assist in the organisation's continuous improvement, and this occurs through feedback from the initial processes (El Yacoubi et al., 2014). These improvements are related to the use of raw materials consciously, the delivery of products that meet the expectations and needs of stakeholders, the provision of reliable data for performance analysis, and

improvements in their production processes, among others (El Yacoubi et al., 2014). As from Annex SL and the characteristics identified in the IMS development proposals analysed in this work, the main actions necessary to develop and implement an IMS were grouped, ordered according to the phases they belong to in the Plan-Do-Check-Act (PDCA) cycle, and characterised according to the hierarchical decision level (strategic, tactical, or operational), which resulted in the actions presented in Table 3.

2.3 Agile methodology

The agility construct is related to the project team's capacity to swiftly adapt the project plan in response to customer or stakeholder needs, market dynamics, or technological shifts, looking to enhance design and product performance in innovative and dynamic environments (Conforto et al., 2016). Agile methodologies emerged as a management approach that is particularly suited for complex projects. AM's core focus revolves around achieving rapid and continuous deliveries within shorter cyclical periods compared to traditional management approaches. This gradual development approach ensures that customer needs are incorporated into each iterative cycle, is highly adaptable, and emphasises progressive requirement construction through short planning and execution iterations (Hidalgo, 2019). Similarly to IMS literature, the foundational principles of agile methods were inspired by the PDCA cycle, originating from Toyota's production methods in the 1950s, which advocated continuous improvement through evolutionary cycles. Key motivators for the adoption of agile practices typically include continuous feedback from stakeholders, easy management of changing requirements, and a strong focus on delivering value. (Santos and Carvalho, 2021; Silva et al., 2022).

Agile methodology is grounded in incremental requirement delivery and continuous stakeholder involvement, offering several benefits such as flexibility in embracing changes, swift responsiveness, and the ability to modify project scope and assumptions (Conforto et al., 2016; Zakrzewska et al., 2022). In the context of Integrated Management System project management, Agile Methodologies serve as essential tools for translating corporate policies, objectives, and strategies into project procedures. The adoption of AM enhances project execution efficiency, flexibility, and agility, particularly in innovation-intensive projects like IMS (Azanha et al., 2017). The literature presents various types of AM, including Extreme Programming (XP), Scrum, Kanban, and Microsoft Solutions Framework (MSF). These agile tools provide guidelines for breaking down work into smaller tasks optimising the development process (Hidalgo, 2019; Zakrzewska et al., 2022). Agile methodologies are rooted in empiricism and employ an interactive and incremental approach to deliver value, improve comprehension, and reduce overall project risks (Azanha et al., 2017; Hidalgo, 2019). They adhere to principles such as empirical process control, self-organisation, collaboration, prioritisation, time-boxed events, and iterative-incremental development. Due to their dynamic and cyclical nature, agile methods

find significant applicability in competitive, uncertain, or volatile environments (Azanha et al., 2017; Zakrzewska et al., 2022).

The adoption of AM not only promotes shared knowledge but also motivates teams to embrace these principles within the workplace. Communities of practice play a pivotal role by facilitating knowledge exchange among diverse teams, thereby enhancing communication frequency, fostering networking, facilitating informal team coordination and trust among teams, fostering maturity, and sharing a common mindset. Frequent planning events enhance comprehension of business requirements, align next steps, and facilitate revisions and shared responsibilities across the organisation with client involvement and commitment (Šmite et al., 2017).

2.4 Systematisation of Agile elements

The main elements in agile methodology are the division of the team by the functions (product owner, development team, and master), the definition of "done", agile planning, interactive-incremental, prioritisation, time-boxed, product backlog, sprint backlog, daily activities, Kanban, sprint review e sprint retrospective, as detailed in Table 2.

Table 2 – Key Agile Elements

Elements	Description	References
Division of the team by the functions	Clear definition of the different functions necessary for the development of the IMS (Product Owner, Development Team, and Scrum Master	Hidalgo (2019) and Dingsoyr et al. (2012)
Definition of "done"	Determines the necessary requirements for a job to be considered as "done", contributing to a better alignment, and minimising possible internal communication problems	Srivastava and Jain (2017), López-Alcarria et al. (2019)
Agile Planning	A more comprehensive initial planning, complemented by more detailed planning throughout the development of the IMS, allows greater ease and speed of response to changes, making the implementation of the IMS more adaptive	Hidalgo (2019) and Dingsoyr et al. (2012)
Iterative-Incremental	The development of the IMS occurs incrementally. As the IMS is broken down into smaller elements, its implementation occurs by performing tasks in blocks	Hidalgo (2019)
Prioritisation	It orders the elements to be developed for the implementation of the IMS based on what the top management and the interested parties (customers) consider to be of greater value, emphasising the importance of greater participation and influence of the interested parties in the development of the IMS	Morandini, (2021)
Time-Boxed	Seeks to clearly and precisely determine the duration and scope of events and activities involved in IMS development, and to minimise schedule delays, unnecessary work, and increased costs	Srivastava and Jain (2017), Alcarria et al. (2019) and Azanha et al. (2017)
Product Backlog	Divides IMS development into smaller tasks, which helps in their execution, and orders them according	Srivastava et al. (2017), Hidalgo (2019) and

Elements	Description	References
	to the prioritisation established by top management and stakeholders	Dingsoyr et al. (2012)
Sprint Backlog	Selects the IMS elements of greatest value to top management and stakeholders to be developed first in the cycle (Sprint)	Srivastava and Jain (2017), Hidalgo (2019) and Dingsoyr et al. (2012)
Daily Meeting	Contributes to a fast, objective, and effective daily alignment regarding the performance of the necessary activities for the development of the IMS	Srivastava and Jain (2017), Hidalgo (2019) and Dingsoyr et al. (2012)
Kanban	It makes the IMS development workflow more visual and organised, promoting greater transparency in work processes, providing a means of displaying work tasks to the team, communicating priorities, making it easier to identify bottlenecks, and assisting in optimising efforts.	Srivastava and Jain (2017), López-Alcarria et al. (2019) and Azanha et al. (2017)
Sprint Review	The participation of stakeholders in the development of the IMS increases through feedback and serves as input for future updates on what needs to be accomplished for its implementation (Product Backlog)	López-Alcarria et al. (2019) and Azanha et al. (2017)
Sprint Retrospective	Focuses on continuously and gradually increasing the performance of the team responsible for the development of the IMS	Azanha et al. (2017)

The agile methodology aims to break work into small tasks that a team can complete within predetermined cycles, typically lasting from one to four weeks. These cycles, known as Sprints, serve to monitor project progress and optimise the development process incrementally and gradually (Hidalgo, 2019; López-Alcarria et al., 2019; Zakrzewska et al., 2022). Within an agile team, three primary roles exist: the development team, the product owner, and the master, coach, or facilitator, depending on the chosen method. The development team takes on the responsibility of designing, building, and testing the desired product or service. This team typically comprises 5 to 9 multidisciplinary individuals who collaborate to determine the most effective approach for achieving the goals set by the product owner. The product owner, on the other hand, specifies all product requirements, which are then transformed into a delivery list known as the Product Backlog. Ideally, a single individual occupies this role to ensure clear communication of decisions to the development team (Dingsoyr et al., 2012; Hidalgo, 2019; López-Alcarria et al., 2019). The product owner also maintains direct contact with customers to align the product's progress with their expectations. The master, acting primarily as a mentor and facilitator for the development team, plays a crucial role in helping stakeholders understand and support agile principles and practices, resolving problems, and ensuring the effective application of agile methodologies. Removing obstacles that impede team productivity is a key function of the master (Hidalgo, 2019; Dingsoyr et al., 2012).

Sprints aims to deliver the Sprint Backlog, a selection of items from the Product Backlog to be incorporated into the product during the current Sprint. Each Sprint

incorporates the concept of the "Definition of Done," representing a formal agreement between the Product Owner and the Development Team regarding the criteria for considering a work item as "done" (López-Alcarria et al., 2019; Morandini, 2021; Zakrzewska et al., 2022). At the onset of each Sprint, the team conducts a Sprint Planning meeting to define the Sprint's goals and create the Sprint Backlog. We recommend a maximum duration of 8 hours for this meeting in the case of four-week Sprints (Azanha et al., 2017; Alcarria et al., 2019; Zakrzewska et al., 2022). During each day of Sprint development, the team holds a brief meeting called the Daily Standup, which serves to informally plan the day's activities. This meeting involves only the members of the Development Team and should not exceed 15 minutes (Azanha et al., 2017; Zakrzewska et al., 2022).

At the end of the Sprint, a meeting called the Sprint Review involves project clients, the Development Team, the Product Owner, and the Master, essentially encompassing both clients and the entire team. The Sprint Review, with a proportional maximum duration of 4 hours for four-week Sprints, aims to gather feedback from customers regarding the product's incremental development. This feedback informs updates to the Product Backlog, which the Product Owner can make as needed (Azanha et al., 2017; Srivastava and Jain, 2017; López-Alcarria et al., 2019). Following the Sprint Review on the same day, the team conducts the Sprint Retrospective meeting, focusing on developing action plans for improvement in subsequent Sprints, with a proportional maximum duration of 3 hours for four-week Sprints. Participants in this meeting include the Development Team, the Product Owner, and the Master, but it does not involve the product's customers, as in the Sprint Review. In agile methodology, product increments are delivered as soon as they hold sufficient value for use and feedback generation, a moment termed "Release." This event engages the Development Team and the Product Owner (Azanha et al., 2017).

3 RESEARCH METHOD

This work was developed in five steps, as shown in the methodology flow in Figure 1. In Step 1, the theme of the work was established, the gap for this study was identified, and the key elements necessary for its development, such as the objective, the question, and the research method, were defined. In Step 2, a literature review on integrated management system and on Agile was elaborated to identify and systematise the main characteristics of these themes. In step 3, the articles present in the Scopus and Web of Science (WOS) databases that deal specifically with proposals for "IMS development" were selected and analysed. The selection was performed in 2021 and had as search parameters the string Integrated Management System* AND guideline* OR recommendation* OR model* OR approach* OR tool* OR method* OR "development" OR "implementation" searched in the fields Article title, Abstract and Keywords. The types of documents analysed were articles and reviews in English, and there was no limitation as to the date of publication to find all articles in these databases that

specifically addressed "IMS development". With the intersection of the results obtained in each database, 17 publications were found, of which 7 were outside the scope of the study and were excluded, resulting in 10 articles with proposals for IMS development, as will be presented in Table I of Section 4 of this article.

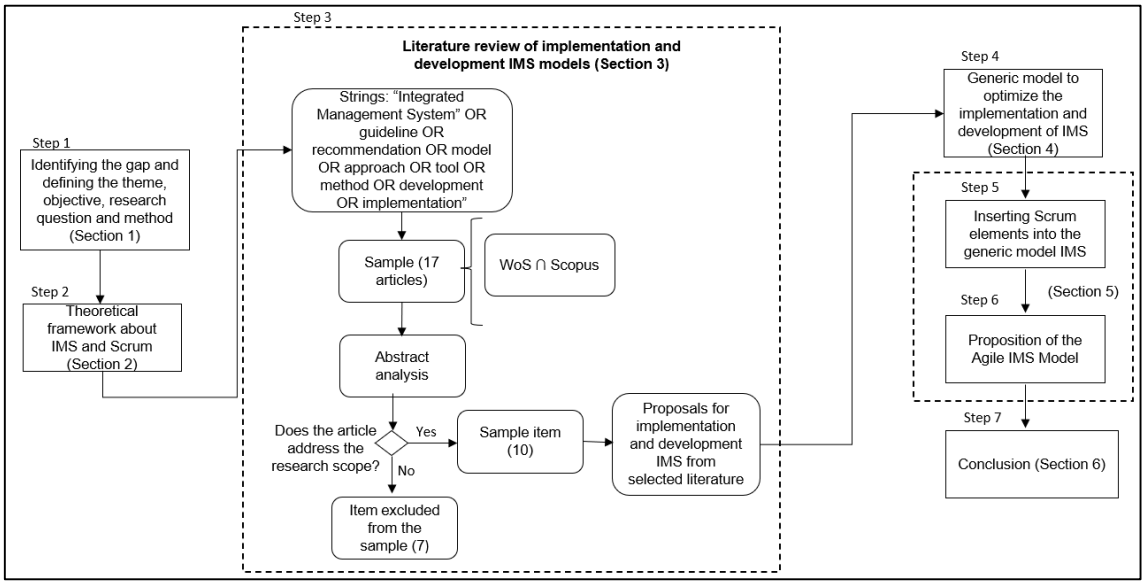

Figure 1 – Research methodology flow

In Step 4, the proposals for IMS development contained in the 10 articles were then analysed to identify their main characteristics. Through the individual and cross-analysis of the proposals, it was possible to identify their main characteristics, convergences, and divergences, resulting in the systematisation of a generic model from the selected articles. Step 5 aims to connect agile elements with IMS. Initially, our search focused on the overlap between two key themes: "agil* (Topic)" and "integrated management system* (Topic)," yielding just 13 documents, 8 proceeding papers and 5 articles. In response, we broadened our search to conduct a more comprehensive review of seminal agile literature to pinpoint essential characteristics. This content analysis enabled us to identify the fundamental agile elements to incorporate into the proposed framework. Consequently, in step 6, we are now poised to develop the "Agile IMS Model" proposal. In step 7, the conclusion of the work was prepared to confirm the achievement of the objective and the answer to the research question, highlighting its main contributions and proposing suggestions for future studies on the integrated use of IMS, Agile, and other AM.

4 PRESENTATION AND DISCUSSION OF RESULTS

Through individual and cross-analysis of the proposals identified in the literature (Table 1), it was possible to identify their main characteristics, convergences and divergences, resulting in the systematisation of a generic model (Section 4.1).

Subsection 4.2 discusses the main results obtained during this study, which made developing the agile-based IMS framework possible.

4.1 Systematisation of the generic IMS model

Table 1 in section 2.2 summarises the results of stage 3, identifying the ten articles that dealt specifically with IMS development and which served as the basis for systematising the generic IMS model presented in Table 3.

Table 3 – Systematisation of the generic model

		Strategic	Tactical	Operational
PLAN	**P1.** Identify and analyse the current state of management systems	✓	✓	
	P2. Create a project to develop the IMS	✓		
	P3. Have an integrative view of programs and projects	✓	✓	
	P4. Analyse the product/service	✓	✓	
	P5. Develop a culture of integration in the organisation	✓		
	P6. Integrate management systems policies	✓	✓	
	P7. Identify the current state of the organisation regarding legal requirements and stakeholders	✓	✓	
	P8. Integrate resources and allocate them in a balanced way between the different areas of the IMS	✓		
	P9. Integrate structure, roles, and responsibilities	✓		
	P10. Provide full support to corporate sustainability management	✓	✓	
DO	**D1.** Create an integrated management manual		✓	
	D2. Conduct training and awareness and develop competencies of employees in an integrated manner		✓	
	D3. Establish stakeholder communication, participation and consultation	✓	✓	
	D4. Document and control documents in an integrated manner	✓	✓	✓
	D5. Perform integrated management of operations		✓	✓
CHECK	**C1.** Measure and monitor the performance of processes and products in an integrated manner		✓	
	C2. Manage the specific requirements of each MSs separately	✓	✓	

		Strategic	Tactical	Operational
CHECK	**C3.** Investigate incidents, accidents, impacts and environmental aspects		✓	✓
	C4. Analyse and control non-conforming products		✓	✓
	C5. Conduct internal and external audits in an integrated manner		✓	✓
	C6. Create employee incentive and recognition programs	✓	✓	
	C7. Develop eco-efficiency programs for environmental improvement	✓	✓	
	C8. Development of cultural and citizenship programs to improve the working environment	✓	✓	
ACT	**A1.** Define a continuous improvement plan for the IMS	✓	✓	
	A2. Identify the causes and propose solutions for incidents, accidents, non-conformities, impacts and environmental aspects	✓	✓	✓
	A3. Implement corrective and preventive actions in an integrated manner	✓ ✓	✓ ✓	✓
	A4. Hold integrated critical review meetings	✓ ✓	✓ ✓	

The first group of tasks is related to the "Plan" stage and is conducted in a macro way by the members of the strategic level. This group consists of 10 actions (P1, P2, P3, P4, P5, P6, P7, P8, P9, and P10). Planning the IMS based on the organisation's objectives and interests is the responsibility of the top management, but it needs the support of the managers (tactical level) to obtain information about the stage at which the MSs are present. The first item, "Identify and analyse the current state of management systems", consists of performing an analysis of the MHs, to verify what needs to be developed and what eventually has already been implemented in terms of integration. The tactical level participation in this item is very important due to the knowledge and experience acquired in implementing and maintaining the organisation's MSs.

"Create a project to develop the IMS" seeks to conduct project planning for IMS implementation or improvement, which includes defining and/or updating objectives, goals, project analytical framework, resources, costs, IMS programs, integrated emergency response plans, and conducting a risk analysis. "Having an integrative view of programs and projects" consists of seeking synergy between the parties involved from the design, construction, and implementation to the control of the developed system. "Analyse the product/service" is about assessing the requirements of the product or service, as well as aspects, impacts, hazards, and risks, from an integrated viewpoint. "Develop a culture of integration in the

organisation" is based on including or emphasising the importance of integration in the mission, values, and culture of the organisation by including this mindset in the way employees carry out their activities.

"Integrate management systems policies" consists of analysing and comparing the policies of the individual MSs and then integrating them, resulting in a single policy that involves all the MSs. "Identify the current state of the organisation regarding legal requirements and stakeholders" corresponds to analysing the company's current state and adjusting it to the decrees, laws, resolutions, ordinances, normative instructions, and stakeholders' requirements and satisfaction. "Integrate resources and allocate them in a balanced way between the different areas of the IMS" means managing the resources destined for the integration of the IMs so that there is no favouring or harming any area of the organisation, which would reflect in disharmony caused by a failed integration.

"Integrate structure, roles and responsibilities" aims to optimise the use of infrastructure and train and motivate existing human resources to benefit the IMS. "Providing full support to corporate sustainability management" implies stimulating managers and providing financial, human, and structural resources to develop effective actions that promote positive social and environmental impacts on the company and its community to generate financial performance to be converted into a competitive advantage. The second group of tasks represents the "Do" step of the PDCA cycle. This group consists of 5 actions (D1, D2, D3, D4, and D5).

The item "Create an integrated management manual" corresponds to integrating the manuals of each IMS into one, which should be performed jointly by the strategic and tactical levels so that there is alignment between the organisation's objectives and the goals of their departments and the operational level participates in some stages of this action. "Conduct training and awareness and develop competencies of employees in an integrated manner" refers to training employees about the demands of the IMS, which is the responsibility of the tactical level with the direct participation of the human resources sector. "Establish stakeholder communication, participation and consultation" refers to actively communicating and interacting with stakeholders to identify their needs and seek to meet them, which involves the strategic and tactical levels of the organisation. These needs directly impact the organisation; therefore, it is necessary to identify and categorise them according to their importance to make more assertive decisions and conduct effective management with less risk.

"Document and control documents in an integrated manner" consists of integral recording and managing all the information related to the MSs, which all organisational levels must perform. It is very important to constantly update the documentation so that IMS performance can be verified. "Performing integrated management of operations" means the help of management tools to use the infrastructural, human, and financial resources in a joint and synergic way to improve integration and increase the company's competitiveness. This action must be done at the tactical and operational levels. The third group provides actions

from the "Check" phase, which aims to confront the IMS results obtained with those planned. This group consists of 8 actions (C1, C2, C3, C4, C5, C6, C7, C8, C9, C10) ." Measure and monitor the performance of processes and products in an integrated manner" is related to how to perform the monitoring of processes and products through indicators to verify the degree of integration of the requirements of the MSs, which the tactical level should do. The item "Manage the specific requirements of each MSs separately" consists of identifying, monitoring, and continuously improving the elements that cannot be integrated, and it is up to the strategic and tactical levels to do it.

The action "Investigate incidents, accidents, impacts, and environmental aspects" aims to identify and analyse the risks related to quality, occupational health and safety, and environmental issues to develop actions to prevent their recurrence. "Analyse and control non-conforming products" aims to identify, analyse and improve processes and products with deviations from the established standard, which reinforces the importance of effective document management. This action is up to the tactical and operational levels. "Conduct internal and external audits in an integrated manner" means joining efforts to verify the integration level of the processes related to quality, environment, and occupational health and safety; and to identify opportunities for continuous improvement in this integration, whose action is the responsibility of the tactical and operational levels. "Creating employee incentive and recognition programs" corresponds to recognising and rewarding employees for their behaviour and engagement in favour of the integration of management systems to stimulate them to seek a high level of performance, which should be developed at the strategic and tactical levels.

The item "Develop eco-efficiency programs for environmental improvement" means introducing elements related to life cycle analysis, cleaner production, and the 3Rs (reduce, recycle, and reuse) in the company's processes to contribute to cost reduction and preservation of the planet and society, which the strategic and tactical levels should carry out. "Development of cultural and citizenship programs to improve the working environment" consists of creating initiatives with the purpose of increasing ethnic, generational, and gender diversity in the company and improving the working environment, which has a direct impact on the professionals' views and satisfaction regarding their jobs. This action is up to the strategic and tactical levels, and these initiatives, when well-designed, can motivate employees and increase productivity in the organisational environment.

The fourth and last group, the "Act" stage of the PDCA cycle, aims to correct any deviations in the activities performed about the planned one and, consequently, to propose future improvements to avoid their recurrence. This group consists of 4 actions (A1, A2, A3, and A4). This action is performed at the strategic, tactical, and operational levels. "Define a continuous improvement plan for the IMS" aims to identify possible actions aimed at optimising IMS results, which can occur through self-assessment, management review of projects and processes, and analysis of stakeholders' satisfaction level. This activity should involve all organisational levels. "Identify the causes and propose solutions for incidents,

accidents, non-conformities, impacts, and environmental aspects" consists of using the solutions and continuous improvement tools already widely known in the literature (quality control circle, Ishikawa diagram, 5W2H, ...) to ensure a healthy and safe environment for employees.

"Implement corrective and preventive actions in an integrated manner" corresponds to the basis of quality, environment, and occupational health and safety management, which aims to analyse in an integrated manner the actions required to reduce failures, deviations in processes and products, and improvements in environmental and occupational health and safety issues to avoid their recurrence in the future, an action that all organisational levels must perform. "Hold integrated critical review meetings" is the evaluation of the IMS from a more strategic perspective by the top management. This meeting should ensure the alignment of the IMS with the organisation's mission, vision, values, and strategy. Despite the greater responsibility of the top management in this action, this meeting is developed using information from the tactical and operational levels.

4.2 Proposition and discussion of the agile-based IMS framework

The proposed framework encompasses both Agile Methodologies and Integrated Management Systems as foundational elements for the development of the Agile-based Integrated Management Systems framework, grounded in PDCA (Plan-Do-Check-Act) cycles. An overview of the key elements of this analysis and the overarching framework is presented in Figures 2 and 3. Figure 2 concisely represents team dynamics and framework events, offering a synthetic perspective on their interplay. Figure 3 delineates the essential steps for AIMS development within the PDCA cycle, delineating three distinct levels of analysis: strategic, tactical, and operational.

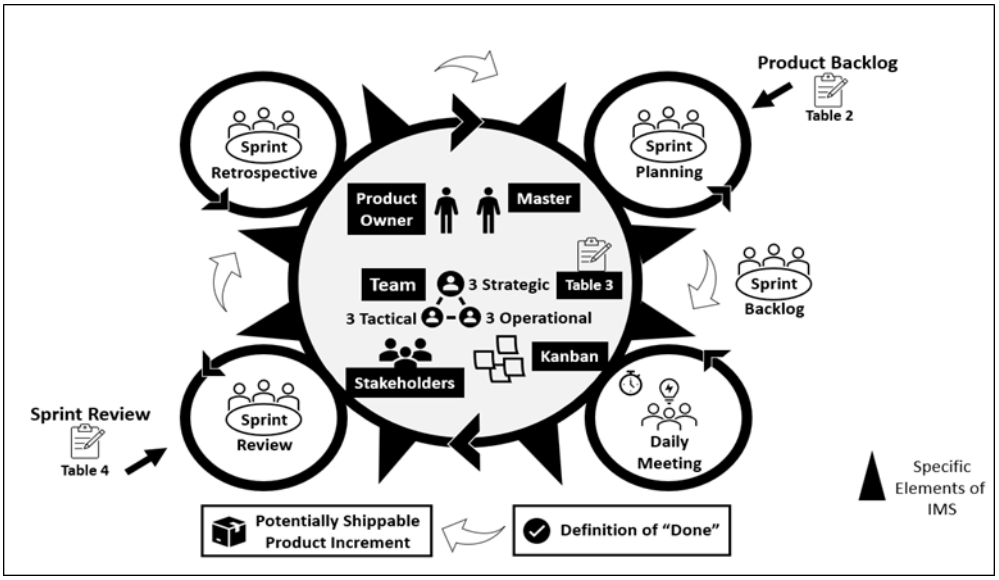

Figure – 2 Agile-based IMS (AIMS) Framework – events and team dynamics

For AIMS implementation, it is necessary to define the agile artefact itself, which is the AIMS framework developed collaboratively by the project team, as suggested by Hidalgo et al. (2019). This initial step involves establishing clear roles within the team, specifically a Product Owner, an Agile Master, and a Development Team. The Product Owner's role is well-suited for individuals with extensive experience and advanced knowledge in IMS. Their primary responsibility is to specify the requirements essential for IMS development. The Agile Master (or coach or facilitator, depending on AM type), conversely, can be any team member with an intermediate level of knowledge in IMS but with strong knowledge of AM, recommended AM certification. The certification ensures a baseline competency level, irrespective of the individual's position within the organisation. As for the Development Team, it is recommended that this team is comprised of a maximum of nine members drawn from various organisational areas. Typically, this would consist of three members from the strategic level, three from the tactical level, and three from the operational level, as Hidalgo et al. (2019) suggested. These team members should possess a fundamental understanding of both IMS and Agile methodologies. The actual composition may vary depending on the organisation's size and the project's complexity, but maintaining a team size of up to nine individuals is advisable to preserve agility, as Dingsoyr et al. (2012) suggested. Figure 2 provides an AIMS framework's synthetic perspective of events and team dynamics interplay.

Table 3 contains the systematically structured IMS generic model encompassing essential actions for IMS development within the PDCA cycle, which serves as a foundational reference for the Product Owner when preparing the IMS Product Backlog. The actions corresponding to the "Plan," "Do," and "Check" phases of the PDCA cycle (as detailed in Table 3) constitute the basis for constructing the proposed AIMS framework, specifically for shaping the Product Backlog in three levels of analysis, strategic, tactical, and operational, as shown in Figure 3. Concurrently, the actions that constitute the "Act" cycle phase now form the foundation for the development of the "Sprint Review." The sequence of these actions must align with the priorities identified by customers, with top management and stakeholders establishing the development order for these elements. Once the requirements present in the Product Backlog have been identified, analysed, and prioritised, along with estimated deadlines, it becomes imperative to establish a Definition of Readiness. This definition represents a formal agreement between the Product Owner and the Development Team, outlining the specific actions that must be executed within the Sprint for it to be considered "ready" deadlines (Morandini, 2021; Sutherland, 2014).

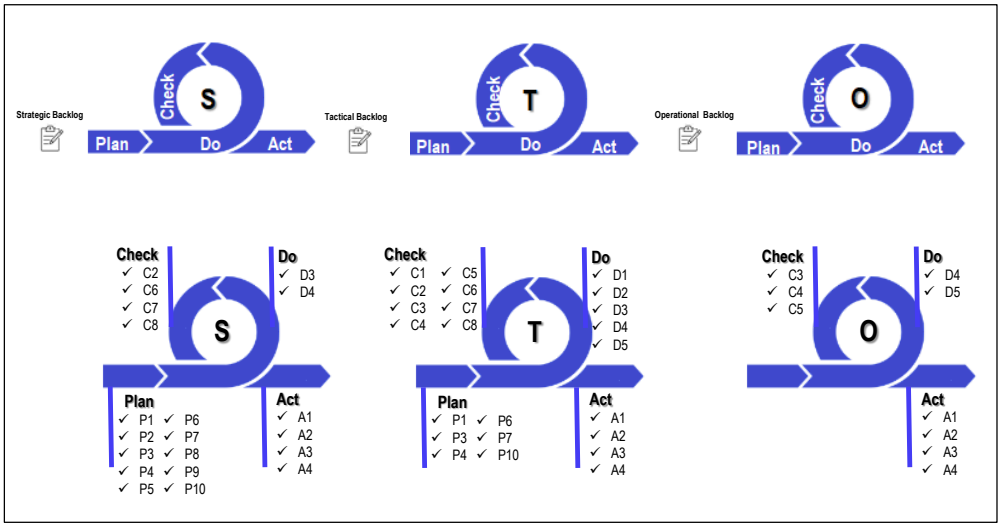

Figure 3 – AIMS Framework – backlog and levels of analysis
Note: See codes of activities in Table 3

On the first day, Sprint Planning should take place, which is a meeting to plan what will be accomplished in the Sprint Backlog. The Sprint Backlog involves the Product Owner, Agile Master, and Development Team and consists of the choice of the elements of the Product Backlog to be developed, considering the prioritisation established by top management and stakeholders. The maximum duration must be 8 hours for four-week Sprints, but this may vary according to the company's needs, for example, in three weeks, but with a maximum duration of 6 hours (Hidalgo, 2019; Morandini, 2021). In the Sprint Backlog, it is possible to identify one of the Agile principles called Time-Boxed, in which the events have predetermined fixed times and a clear definition of what must be accomplished (Morandini, 2021). Sprint Execution consists of implementing the IMS elements listed in the Sprint Backlog. At the end of each day of Sprint Execution, the Daily Agile occurs, which is a daily meeting that seeks the analysis and alignment of the activities required for the development of the Sprint on the next day. This meeting is held only among members of the IMS Development Team and lasts a maximum of 15 minutes. A widely used technique for conducting the Daily Agile is the Stand-up Meeting, which aims to hold quick meetings that meet their predetermined deadlines (Morandini, 2021; Sutherland, 2014).

Among the elements present in the Sprint Backlog, some will be selected and added (as prioritised by the stakeholders) as increments to what has already been developed in each Sprint. The increment is the partial delivery of the product (IMS) in each Sprint, i.e., it is like a puzzle piece; in the first Sprint, the complete picture of the puzzle cannot be visualised, but as the Sprints are developed, the pieces are being positioned. At the end of each Sprint Execution, an IMS increment is expected to be ready (according to the Ready Definition) and can be presented to top management and stakeholders. After the Sprint Execution, there is a Sprint Review, which is a meeting consisting of top management, stakeholders, the Product Owner, the Agile Master, and the IMS Development Team (Hidalgo,

2019; Dingsoyr et al., 2012). The Sprint Review lasts four hours for four-week Sprints but may vary according to the company's needs and aims to obtain feedback from top management and stakeholders regarding the product development increment. This feedback will be used as input when the Product Owner updates the Product Backlog, a procedure that should be performed whenever necessary (Sutherland, 2014).

After the Sprint Review, the Sprint Retrospective begins, which aims to develop action plans with improvement points for the next Sprint and the continuous and incremental optimisation of the project team's performance through training. The maximum duration is 3 hours for 4-week Sprints and involves the Agile Master, the Product Owner, and the Development Team. After the Sprint Review activities, Sprint Planning begins. This cycle repeats until all IMS elements listed in the Product Backlog are implemented by the team and approved by senior management and stakeholders (Morandini, 2021; Sutherland, 2014). Given this, it is observed that all cycles of the agile IMS model proposed in this paper focus on the prioritisation established by the top management and stakeholders, which concerns another fundamental principle of Agile. As the product is divided into smaller elements to facilitate the IMS development process, the final product comprises many items that top management and stakeholders require. Consequently, during the project, there are several deliverables corresponding to these items. Thus, prioritisation is essential for the project scope to be fulfilled and the deadlines to be respected to avoid unnecessary work and possible delays in the schedule (Morandini, 2021). Prioritisation is directly related to customer focus. The IMS elements that will be developed in the respective Sprint should be organised according to the level of value assigned by senior management and stakeholders, and those with the highest levels should be prioritised and delivered as soon as possible (Hidalgo; 2019; Morandini, 2021). The team responsible for this project (Product Owner, Development Team, and Agile Master) should plan in a generalised manner only what is necessary for the start of IMS development. Following Agile principles, the IMS can be divided into smaller elements in a gradual, iterative manner, such as "develop integration culture in the organisation", "integrate management system policies", and "identify the organisation's current state concerning legal requirements and stakeholders that would be developed from small deliverables. Thus, at the beginning of each cycle, some of these elements should be chosen from the demand of the top management and stakeholders, and more detailed planning should be done to establish how the IMS Development Team should organise itself to deliver the selected increments for the respective Sprint (Srivastava and Jain, 2017; Hidalgo, 2019).

5 CONCLUSION

This study contributes to the existing body of knowledge in two significant ways. Firstly, it delivers an in-depth review of IMS models and the key components of AM. Secondly, it introduces a framework that encompasses a range of IMS models

through the lens of AM. The AIMS model proposed in this study represents an interdisciplinary endeavour that amalgamates insights from heterogeneous extant research from different disciplines while exploring synergies among approaches, providing a more general structure to open room for future research. The amalgamation of AM in the development of IMS is unprecedented and was not previously identified in the literature. The Agile-based Integrated Management System framework proposed in this study offers the perspective of three levels of analysis: strategic, tactical, and operational. Integrating IMS and AM empowers organisations to make quicker and more adaptable decisions about IMS implementation. In this framework, the IMS backlog is defined concurrently with its development, demonstrating an adaptive nature in contrast to the traditional project scope approach. The scholarly contribution of this research lies in the convergence of theoretical foundations related to IMS with AM, both grounded in the PDCA cycle and customer-oriented. This amalgamation has given rise to a novel body of knowledge, opening avenues for further research exploration. The practical contribution of this work is to assist managers in companies of varying sizes and across different segments in developing IMS in a more agile, flexible, and responsive manner. Companies already acquainted with the agile methodology will find it easier to implement the proposed model due to their familiarity with the concepts and tools utilised in the AIMS framework. Some limitations warrant acknowledgement. Firstly, the framework presented in this study was constructed through a literature review, lacking empirical testing. Empirical validation is crucial to explore the framework's applicability and effectiveness. Secondly, the framework maintains a general perspective, and contextual variables have not been thoroughly explored. Future research needs to delve into the contextual nuances that may influence the implementation of Agile-based Integrated Management Systems. Therefore, we recommend that future research endeavours focus on conducting case studies of AIMS implementation in various contexts. This approach would provide a more in-depth understanding of how the framework operates in real-world scenarios and how contextual factors impact its implementation and outcomes.

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Conceptualization, F.E.F. and O.J.O.; Methodology, F.E.F, J.N., and O.J.O; Validation, G.S., M.M.C and O.J.O; Investigation, F.E.F and I.K.; Resources, O.J.O.; Original draft preparation, I.K, F.E.F, O.J.O.; Review and editing, F.E.F, J.N., M.M.C, C.C, O.J.O.; Supervision, O.J.O., G.S.; Project administration, F.E.F and O.J.O.; Funding acquisition, O.J.O. and G.S.

CONFLICTS OF INTEREST

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