



Perceptions Regarding Quality Management Systems of Moroccan Medical Laboratory Practitioners: A Cross-sectional Study

Mohammed El Feniche^{1,2,*}, Hassane Gazzaz^{3,4}, Hajar El Omari^{2,5}, Karima EL Mouhdi^{2,5}, Mounir Arai^{6,7}, Yassine El Aatik⁸, Abdelghani El Ouardi⁸, Anass Kharrazi¹ and El Arbi Bouaiti¹

¹Laboratory of Biostatistics, Clinical, Research and Epidemiology, Faculty of Medicine and Pharmacy, Mohammed V University, 10100 Rabat, Morocco

²Ministry of Health and Social Protection, Higher Institute of Nursing Professions and Health Techniques (ISPITS), Fez/Meknes, Morocco

³Ministry of Health and Social Protection, Higher Institute of Nursing Professions and Health Techniques (ISPITS), Rabat/Kenitra, Morocco

⁴Faculty of Medicine and Pharmacy, Mohammed V University, 10100Rabat, Morocco

⁵Natural Resources Management and Development Team, Laboratory of Health and Environment, Faculty of Sciences, Moulay Ismail University, 50000 Meknes, Morocco

⁶Higher Institute of Nursing Professions and Health Techniques (ISPITS), Casablanca, Morocco

⁷Faculty of Medicine and Pharmacy, University Hassan II, Casablanca, Morocco

⁸Research Laboratory of Psychiatry, Medical Psychology and History of Medicine, Faculty of Medicine and Pharmacy, Mohammed V University, 10100Rabat, Morocco

Abstract:

Background: The Quality Management System (QMS) is essential for guaranteeing the reliability of results in medical laboratories. This study explored the perceptions of medical laboratory practitioners in Morocco regarding the QMS.

Objective: This study aimed to explore the perceptions of medical laboratory professionals in Morocco regarding Quality Management Systems (QMSs), identify the main obstacles to their implementation, and analyze the socio-demographic factors influencing these perceptions.

Methods: This study used a cross-sectional quantitative design conducted in Morocco, involving 464 participants. Data were analyzed using SPSS version 22. The study used a scoring method to assess levels of perception and applied the chi-square (χ^2) test and binary logistic regression to assess associations between variables.

Results: Over 90% of respondents recognized the benefits of QMS, but identified three main obstacles: an additional workload (53.66%), a significant financial cost (43.10%), and time-consuming implementation (45.47%). In addition, the results showed strong Pearson correlations between overall perception and age ($p = 0.032$), particularly in the 50-60 age group, where 54.17% expressed positive opinions. The binary logistic regression results indicated practitioners' perceptions to be influenced by age, gender, and profession.

Conclusion: The results highlighted the need to increase awareness of the importance of QMS among professionals as well as support laboratories in establishing a robust organizational framework to ensure effective management of resources and improve the integration of the QMS with other systems, such as the management information system and the external audit program.

Keywords: Accreditation, Laboratory technicians, Biologists, Perceptions, Quality management system, Awareness, Medical laboratories.

© 2024 The Author(s). Published by Bentham Open.

This is an open access article distributed under the terms of the Creative Commons Attribution 4.0 International Public License (CC-BY 4.0), a copy of which is available at: <https://creativecommons.org/licenses/by/4.0/legalcode>. This license permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.



Received: October 18, 2024
Revised: November 04, 2024
Accepted: November 27, 2024
Published: December 31, 2024

*Address correspondence to this author at the Laboratory of Biostatistics, Clinical Research and Epidemiology, Faculty of Medicine and Pharmacy, Mohammed V University, Rabat, Morocco; Tel: +212662286366; E-mail: fenich111@gmail.com

Cite as: El Feniche M, Gazzaz H, El Omari H, Mouhdi K, Arai M, El Aatik Y, El Ouardi A, Kharrazi A, Bouaiti E. Perceptions Regarding Quality Management Systems of Moroccan Medical Laboratory Practitioners: A Cross-sectional Study. *Open Public Health J*, 2024; 17: e18749445363860. <http://dx.doi.org/10.2174/0118749445363860241205063519>



Send Orders for Reprints to
reprints@benthamscience.net

1. INTRODUCTION

In a context where the quality of healthcare services is a central concern, implementing robust Quality Management Systems (QMS) in Medical Laboratories (ML) is essential. These systems enable efficient patient care while minimizing errors and guaranteeing appropriate control measures. Thus, a well-structured QMS ensures the rigor of diagnostic processes, improves the reliability of results, and promotes optimal management of resources, therefore contributing to the overall quality of care [1].

However, introducing a QMS is not without consequences for laboratory professionals. They are faced with a reorganization of tasks and an increase in workload [2]. The QMS is sometimes perceived as time-consuming, requiring significant involvement in document management, monitoring quality indicators, and carrying out internal audits [3, 4]. In addition, the costs associated with its implementation, particularly in terms of continuing training and the acquisition of new technologies, can be considered high [5, 6]. Other surveys have revealed structural deficiencies, including inadequate technological infrastructures, which include the absence of robust information systems and suitable digital devices [7, 8]. In addition, leadership challenges, marked by a lack of strategic foresight and a lack of commitment from decision-makers, are a significant barrier to the assimilation of QMS [7]. Moreover, there is inherent cultural resistance, particularly in environments where quality standards have not yet been integrated into professional practices, resulting in insufficient compliance with change initiatives [9]. These gaps in perceptions of quality management can hinder continuous improvement and compliance with standards [10]. Similarly, a negative perception can be intensified by insufficient training and knowledge [11-13]. Consequently, it is imperative to develop scalable programs adapted to resource-limited contexts, providing specialized modules, hybrid methodologies integrating online and face-to-face teaching, and resources easily accessible through simple technologies [14, 15].

Despite these constraints, QMS in laboratories offers many advantages, particularly in terms of accuracy and reliability of results [16, 17]. Indeed, a well-structured QMS ensures that processes are rigorously planned and controlled, reducing errors that could compromise patient

safety, while improving sample and resource management [18]. In addition, it enables to implement procedures that guarantee the integrity of the results provided to patients, thus helping to improve the quality of care [19]. Furthermore, the QMS reinforces professional knowledge [20] and the collective responsibility of employees, as shown by a study that indicated over 97% of laboratory professionals to be aware of the importance of QMS and consider its application a shared responsibility [21]. Moreover, this system improves operational efficiency by reducing sample rejections and optimizing the use of available resources. Finally, it also encourages interdisciplinary collaboration, promoting better coordination among the teams [22, 23].

These positive perceptions often lead to favorable attitudes in the workplace, which are crucial to the successful adoption and implementation of quality standards [10]. Indeed, a favorable view of the QMS plays an essential role in improving the quality culture within the laboratory [3]. Furthermore, adequate training and information on the QMS is not only beneficial, but also essential to enable staff to adopt and implement it effectively [24].

To meet the challenges inherent in implementing QMS, many initiatives have been taken to improve laboratory performance and ensure compliance with established standards. In the Tanzanian context, Beyanga *et al.* highlighted four main priorities: staff capacity building, method validation and verification, systematic application of internal quality control measures, and participation in external quality control programs. These synergistic efforts were designed to enhance the reliability of laboratory services [25]. Furthermore, in the context of Africa and Central Asia, Mateta *et al.* highlighted the beneficial results of the intervention of the Clinical and Laboratory Standards Institute (CLSI) *via* its Global Health Partnerships (GHP) program, which was implemented in 32 laboratories to establish QMSs and improve their performance. This systematic intervention relied on the use of standardized checklists, used before and after the program, to quantitatively assess its effectiveness. The results indicated that a structured program, involving the application of recognized checklists, proactive management support, and professional training complemented by on-site advice, can significantly improve the quality of laboratory services [26].

Nevertheless, these research efforts have mainly taken place in contexts distinct from Morocco, where there is, to our knowledge, a lack of relevant data on this particular issue. This research, therefore, aimed to fill this gap by exploring the perceptions of Medical Laboratory Practitioners (MLPs) in Morocco regarding QMS, thus offering perspectives for improving the culture of quality in laboratory services in the country. This work has thus proposed an innovative approach to prepare Moroccan laboratories for a quality approach by improving their perceptions of this system.

2. METHODS

For the present cross-sectional investigation, we adhered to the protocols delineated in the STROBE Declaration, an international endeavor aimed at enhancing the precision and quality of reporting associated with observational research. This methodological framework guarantees a thorough and transparent exposition of the employed methods, the resultant findings, and their subsequent analysis, by the recognized best practices pertinent to this domain of inquiry [27].

2.1. Study Design

This cross-sectional study was carried out among MLPs operating in all Morocco's health regions. The main objective of this survey was to integrate participants from various sectors to understand their perceptions concerning the QMS. Our study on the perceptions of practitioners in medical analysis laboratories was non-interventional, aimed at gathering information on the opinions of healthcare professionals without altering their behavior or directly intervening in their activities. Thus, no formal ethical approval was sought. However, all moral considerations were rigorously respected; informed consent from participants was obtained, and the confidentiality of data and the anonymity of respondents were guaranteed. These aspects were clearly explained in the questionnaire used for our survey, ensuring the study's ethical and transparent conduct.

2.2. Study Population and Sample

Our research study encompassed a cohort of 1520 laboratory technicians engaged in the public sector within Morocco, 322 biologists operating in the same sector, and another 359 biologists affiliated with the private sector [28]. Nevertheless, the number of public sector laboratory technicians has not been disclosed by the Ministry of Health. The sample size was determined using the formula below, modified for an infinite population.

$$- n = Z^2 * p * (1-p) / e^2$$

- where, n is the sample size;

- Z is the Z-score, which represents the desired level of confidence (1.96 for a 95% confidence level);

- p is the estimated proportion of the population with the characteristic under study (often assumed to be 0.5);

- e is the tolerated margin of error (e.g. 5%).

By leveraging these parameters, we ascertained that

the requisite sample size amounted to 384 participants; however, we opted to integrate 464 individuals to enhance statistical accuracy, diminish the margin of error, and enable a more comprehensive sub-group analysis.

2.3. Data Collection

The data collection process took place from September 2021 to May 2023. Almost half of the questionnaires were distributed in person, while the other half were administered by digital dissemination using Google Forms.

A questionnaire on perceptions of MLPs related to QMS was developed and adapted from several previous studies [2-4, 29]. The questionnaire had three sections: a) general information (5 questions); b) QMS perceptions (6 items), and c) the comments and recommendations section.

2.4. Questionnaire Validation

The questionnaire used in this work underwent a meticulous validation procedure about content, structure, terminology (assessed by experts in the field), brevity, and comprehensibility (approved by face validity) during a preliminary evaluation involving three technicians and two biologists. To reduce the risk of bias in this research work, a series of measures were implemented. Initially, simple random sampling was used to mitigate the risk of selection bias. The questionnaire was distributed in both paper and digital formats to address the problem of non-participation by some professionals within the professional groups. In addition, the confidentiality of participants was guaranteed, thus mitigating the social desirability bias that may have prompted participants to provide answers in line with societal expectations rather than their genuine views.

2.5. Data Processing and Scoring

The types of questions included in the questionnaire were of the 5-point Likert type, designed to assess different aspects of participants' perceptions. Perception questions used a Likert scale, awarding 1 point for 'strongly disagree', 2 points for 'disagree', 3 points for 'neutral', 4 points for 'agree', and 5 points for 'strongly agree'.

To ensure a consistent and comparable methodology for analyzing overall and specific perceptions, Likert scale responses were converted to a standardized 0-100 scale, where "strongly disagree" corresponded to 0, "disagree" to 25, "neutral" to 50, "agree" to 75, and "strongly agree" to 100. Perception scores were classified into two categories, including a positive perception, defined by a score greater than or equal to 75%, and a negative perception for scores below 75%. Negatively worded items were treated in reverse, where a negative response corresponded to a positive perception. An overall average score was calculated for each participant by taking the average of scores obtained on all items after inversion of scores on negative items ("strongly disagree" = 100, "disagree" = 75, "neutral" = 50, "agree" = 25, and "strongly agree" = 0). Finally, participants' mean scores were categorized into positive or negative perceptions, using the same 75%

threshold as applied to perception-specific scores.

Our categorization has been found to be in accordance with previous studies conducted among healthcare professionals [30, 31].

2.6. Statistical Analysis

The spreadsheet (Excel) was exported to SPSS version 22 and coded according to a predefined coding sheet. Descriptive statistics for the present study have been presented in the form of numbers (n) and proportions (%). The Chi-square test was used to assess possible correlations between socio-demographic characteristics and the two levels of global perceptions. Binary logistic regression was used to examine the factors influencing the different types of MLP perceptions of the QMS. A p-value of less than 0.05 was considered to have statistical significance. It is important to highlight that four incomplete records were discarded from the database to safeguard the integrity of the analyses.

3. RESULTS

3.1. Socio-demographic Characteristics

A total of 464 MLPs from various sectors, including the private sector, university hospitals, and the public sector in Morocco, were included in this research. The demographic characteristics of the participants are described in Table 1. The results showed that most participants were under 30 (46.34%), followed by those aged 30 to 40 (29.09%), those aged 40 to 50 and 50 to 60 (10.34% for both), and those over 60 (3.66%). The study population comprised 44.61% men and 55.39% women. A significant proportion of the participants was associated with the private (42.46%) and public (47.2%) sectors, while some were affiliated with university hospitals (10.34%). A significant proportion of respondents had more than ten years' experience (35.99%), the second highest being 3 to 10 years (30.82%), followed by 1 to 3 years (21.34%) and less than 1 year (11.85%).

Table 1. Socio-demographic characteristics of the participants.

Socio-demographic Characteristics		N (%)
Age	Under 30	215 (46.34%)
	30-40 years old	135 (29.09%)
	40-50 years old	49 (10.56%)
	50-60 years old	48 (10.34%)
	Over 60	17 (3.66%)
Gender	Male	207 (44.61%)
	Female	257 (55.39%)
Profession	Laboratory technician	412 (88.79%)
	Biologist	52 (11.21%)
Sector of activity	Public	219 (47.2%)
	Private	197 (42.46%)
	University hospital	48 (10.34%)
Experience	Less than one year	55 (11.85%)
	1 to 3 years	99 (21.34%)
	3 to 10 years	143 (30.82%)
	More than 10 years	167 (35.99%)

Table 2. Laboratory practitioners' perceptions of QMS.

Items	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree	Perceptions	
						Negative	Positive
QMS improves ML performance	6 (1.29%)	6 (1.29%)	30 (6.47%)	93 (20.04%)	329 (70.91%)	42 (9.05%)	422 (90.94%)
QMS improves the image of the ML	4 (0.86%)	5 (1.08%)	31 (6.68%)	99 (21.34%)	325 (70.043%)	40 (8.62%)	424 (91.37%)
QMS develops professional skills	8 (1.72%)	6 (1.29%)	26 (5.6%)	114 (24.57%)	310 (66.81%)	40 (8.62%)	424 (91.37%)
QMS is a workload	103 (22.2%)	112 (24.14%)	101 (21.77%)	83 (17.89%)	65 (14.01%)	249 (53.66%)	215 (46.34%)
Implementing QMS is costly	128 (27.59%)	136 (29.31%)	125 (26.94%)	50 (10.78%)	25 (5.39%)	200 (43.10%)	264 (56.89%)
Implementing QMS in laboratories takes too much time	106 (22.84%)	147 (31.68%)	116 (25%)	74 (15.95%)	21 (4.56%)	211 (45.47%)	253 (54.53%)

3.2. MLPs’ Perceptions of the QMS

The evaluation of MLPs’ perceptions of the quality approach enabled us to measure their involvement, motivation, and commitment to the application of quality practices within medical laboratories (Table 2). The results revealed that over 90% of participants recognized the role of QMS in improving performance, enhancing laboratory reputation, and facilitating the advancement of skills. Concerning perceived obstacles, 43.10% of respondents felt that the QMS required a significant investment, 45.47% said it was time-consuming to set up, and 53.66% considered it an additional workload.

3.3. Factors associated with MLPs’ overall Perception

Table 3 shows significant correlations between MLPs’ overall perception of the QMS and various socio-demographic factors. The analysis indicated that certain variables in particular influence overall perception. Specifically, age correlates positively with overall perception, particularly in the 50-60 age group, where 54.17% of the participants expressed positive opinions, as evidenced by a significant Chi-square value ($p=0.032$). On the other hand, other socio-demographic variables, such as gender, function, sector of activity, and professional experience, showed no significant association with overall perception, as indicated by p-values greater than 0.05. For example, the “gender” variable revealed a slight variation between men (30.92%) and women (36.96%); however, this disparity indicated no statistical significance ($p = 0.172$). A similar absence of significant differences was observed in practitioners’ roles and their corresponding areas of activity.

3.4. Factors associated with different Types of MLPs’ Perceptions of the QMS

Binary logistic regression analysis indicated significant variations in QMS perceptions according to demographic factors, such as age, gender, profession, and experience. People aged between 30 and 50 had a favorable perception of the improvement in laboratory images due to QMS, as evidenced in particular by the significant Odds Ratios (OR). Conversely, people aged 50 to 60 perceived the implementation of a QMS as financially feasible and time-consuming. As far as gender disparities are

concerned, women recognized the effectiveness of QMS in lightening workloads, improving laboratory reputation, and ensuring rapid execution, a view not shared by their male counterparts. Biologists had reservations about the accelerated implementation of the QMS, as evidenced by an OR of 0.34, meaning a greater reluctance than laboratory technicians. In terms of professional experience, employees with more than 10 years’ seniority perceived a significant reduction in workload thanks to the QMS (OR of 3.19) (Table 4).

3.5. Suggestions put Forth by the Respondents

Complementing the quantitative results, the qualitative recommendations provided by participants provided important insights into potential improvements to the QMS in medical laboratories. These suggestions reflected concrete needs and specific expectations of practitioners, highlighting initiatives that should be prioritized to overcome the challenges associated with QMS implementation. At the legislative level, participants urged the formulation of a strict regulatory framework, including mandatory laboratory accreditation, unannounced audits, and the creation of a regional entity dedicated to training, supervision, and regulation. The participants also suggested incorporating the ISO 15189 standard while urging the State to allocate adequate financial and human resources.

As far as organizational structure is concerned, the active participation of staff in the quality initiative, the encouragement of collaborative teamwork, and the development of a quality-oriented culture, were considered essential by the participants. Ongoing training programs, with transparent communication and clear delineation of responsibilities, can prove to be powerful mechanisms for reinforcing professional awareness and fostering collective commitment.

Recommendations made by participants further emphasized the importance of continuous training for all staff, including international internship opportunities, job rotation, and the use of Massive Open Online Courses (MOOCs) to align skills with global standards. Finally, respondents proposed the introduction of process control mechanisms and regular internal audits to ensure continuous improvement.

Table 3. Factors associated with the overall perceptions of MLPs regarding QMS.

Socio-demographic Characteristics		Perceptions		Khi-deux (p-value)
		Negative	Positive	
Age	Under 30	148 (68.84%)	67 (31.16%)	0.032
	30-40 years old	93 (68.89%)	42 (31.11%)	
	40-50 years old	30 (61.22%)	19 (38.78%)	
	50-60 years old	22 (45.83%)	26 (54.17%)	
	Over 60 years	12 (70.59%)	5 (29.41%)	
Gender	Male	143 (69.08%)	64 (30.92%)	0.172
	Female	162 (63.04%)	95 (36.96%)	
Profession	Laboratory technician	265 (64.32%)	147 (35.68%)	0.071
	Biologist	40 (76.92%)	12 (23.08%)	

(Table 3) cont.....

Socio-demographic Characteristics		Perceptions		Khi-deux (p-value)
		Negative	Positive	
Sector of activity	Public	140 (63.93%)	79 (36.07%)	0.722
	Private	132 (67.01%)	65 (32.99%)	
	University hospital	33 (68.75%)	15 (31.25%)	
Experience	Less than one year	38 (69.09%)	17 (30.9%)	0.659
	1 to 3 years	69 (69.69%)	30 (30.3%)	
	3 to 10 years	93 (65.03%)	50 (34.97%)	
	More than 10 years	105 (62.87%)	62 (37.13%)	

Table 4. Factors correlated with MLPs' perceptions of QMS.

-	a) Improved Performance		Image Enhancement		c) Skills Development		d) QMS Reduces Workload		f) Implementation of QMS is Financially Feasible		g) Implementation of QMS is Timely	
	Sig.	OR (95% CI)	Sig.	OR (95% CI)	Sig.	OR (95% CI)	Sig.	OR (95% CI)	Sig.	OR (95% CI)	Sig.	OR (95% CI)
Age range	0.432	-	0.008	-	0.906	-	0.636	-	0.201	-	0.062	-
Under 30 years	-	1	-	1	-	1	-	1	-	1	-	1
30-40 years old	0.788	1.16 (0.4-3.38)	0.014	4.74 (1.36-16.5)	0.987	0.99 (0.31-3.18)	0.213	0.66 (0.34-1.27)	0.487	1.32 (0.61-2.85)	0.367	1.45 (0.65-3.24)
40-50 years old	0.150	4.05 (0.6-27.16)	0.037	14.4 (1.17-176.93)	0.778	1.27 (0.25-6.49)	0.299	0.59 (0.21-1.61)	0.061	3.45 (0.95-12.56)	0.137	2.48 (0.75-8.18)
50-60 years old	0.363	2.31 (0.38-3.99)	0.772	1.32 (0.19-8.86)	0.918	0.92 (0.17-4.85)	0.435	0.65 (0.22-1.92)	0.022	5.21 (1.26-21.49)	0.012	4.86 (1.41-16.74)
Over 60 years	0.818	0.8 (0.12-5.21)	0.195	5.85 (0.4-84.72)	0.458	2.57 (0.21-0.95)	0.975	1.02 (0.27-3.82)	0.171	3.38 (0.59-19.39)	0.939	1.07 (0.17-6.75)
Female	0.971	1.01 (0.49-2.06)	0.017	2.49 (1.18-5.26)	0.388	1.37 (0.67-2.79)	0.028	1.64 (1.05-2.56)	0.660	0.88 (0.51-1.53)	0.019	1.89 (1.11-3.22)
Biologist	0.428	1.87 (0.39-8.87)	0.053	0.36 (0.13-1.02)	0.710	0.81 (0.27-2.45)	0.844	0.93 (0.44-1.94)	0.162	0.49 (0.19-1.32)	0.023	0.34 (0.13-0.86)
Sector of activity	0.322	-	0.551	-	0.786	-	0.257	-	0.800	-	0.184	-
Public	-	1	-	1	-	1	-	1	-	1	-	1
Private	0.400	0.74 (0.37-1.49)	0.275	0.67 (0.32-1.38)	0.750	1.12 (0.55-2.3)	0.534	0.87 (0.57-1.33)	0.506	0.83 (0.49-1.42)	0.312	0.77 (0.47-1.27)
University hospital	0.143	0.45 (0.16-1.31)	0.720	0.79 (0.22-2.87)	0.624	0.76 (0.25-2.28)	0.102	0.52 (0.24-1.14)	0.823	0.89 (0.34-2.37)	0.082	0.43 (0.16-1.11)
Experience	0.255	-	0.338	-	0.686	-	0.163	-	0.050	-	0.233	-
Less than one year	-	1	-	1	-	1	-	1	-	1	-	1
1 to 3 years	0.059	0.13 (0.02-1.08)	0.254	2.07 (0.59-7.19)	0.926	0.93 (0.22-4.04)	0.215	1.65 (0.75-3.62)	0.528	1.39 (0.5-3.86)	0.120	0.51 (0.22-1.19)
3 to 10 years	0.075	0.15 (0.02-1.22)	0.668	0.78 (0.25-2.42)	0.801	0.83 (0.19-3.59)	0.050	2.19 (0.99-4.79)	0.285	1.75 (0.63-4.85)	0.046	0.42 (0.18-0.98)
More than 10 years	0.054	0.1 (0.01-1.04)	0.646	0.64 (0.09-4.2)	0.350	0.42 (0.07-2.56)	0.031	3.19 (1.11-9.18)	0.258	0.43 (0.1-1.85)	0.234	0.49 (0.15-1.59)

4. DISCUSSION

This study aimed to assess MLPs' perceptions of QMS and study the factors associated with it. The results indicated that over 90% of subjects recognized that QMS improves performance, enhances the laboratory's reputation, and promotes skills development. In concrete terms, the QMS contributes to enhancing the reputation of laboratories by ensuring compliance with international standards, such as ISO 15189, and introducing rigorous processes guaranteeing the reliability of results and the satisfaction of stakeholders. QMS accreditation enhances credibility and promotes recognition, collaboration, and

funding. It also plays a key role in the development of professional skills through ongoing training and assessment, thereby strengthening the technical capabilities of practitioners. In addition, the QMS improves overall performance by standardizing processes, monitoring activities using indicators, and reducing errors through corrective action. In this sense, it is pertinent to mention that a recent study by Caduco carried out in Davao, Philippines, which assessed knowledge, attitudes, and practices towards quality management, revealed a generally positive attitude towards quality assurance [29]. Notably, 82% of respondents strongly agreed that QMS

encourages continuous improvement, while 76% felt that it promotes professional development. Furthermore, Luli *et al.* found laboratory professionals in Ethiopia to have a favorable attitude towards the SLMTA (Strengthening Laboratory Management Toward Accreditation) program, recognizing its crucial role in improving laboratory services and healthcare reform [20].

The results of our study indicated that around half of the respondents considered QMS to be costly (43.10%), time-consuming (45.47%), and contribute to excessive workload (53.67%). These results corroborated several previous studies concerning perceived obstacles. A study including 175 laboratory professionals in Ethiopia by Girma *et al.* found that 68.3% of participants viewed accreditation as a workload, and 44.5% reported that accreditation generated high costs [32]. Similarly, studies conducted in China and Iran confirmed our findings by showing that laboratory professionals considered the tasks involved in implementing a QMS as additional work [33, 34]. Also, another survey conducted in three laboratories in Croatia revealed that 68% of technical staff felt that accreditation increased their usual workload [35].

Initiatives, such as the SLMTA program, are striving to overcome these obstacles by improving laboratory management systems; however, the road to accreditation remains difficult and resource-intensive [36]. QMS implementation can be a resource-intensive process, but there are several management and organizational options to mitigate this burden. These include integrating the QMS with existing systems, such as the information management system and external assurance program [37]. Indeed, this integration streamlines organizational processes while avoiding the installation of separate systems, thereby reducing the overall expense of implementing a stand-alone QMS [38]. Also, adequate organizational support with optimal resource management is necessary to reduce the perception of excessive workload, time-consuming aspects, and investment costs. To achieve this, it is essential to invest in an intelligent management system that streamlines report recall processes, reduces the workload of laboratory staff, improves efficiency, and enables laboratory professionals to focus more on critical tasks rather than administrative burdens [39, 40]. In the same vein, Shang *et al.* recommended the development of an efficient online automated quality control system to optimize the quality and stability of control tests while reducing costs [41].

The results of the binary logistic regression analysis showed significant disparities in perceptions of the QMS according to age, gender, and profession. Among practitioners aged 30 to 40 and 40 to 50, the high odds ratios associated with image improvement (OR = 4.74 and OR = 14.4, respectively) indicated that these groups particularly valued the impact of the QMS on professional reputation. This age group may play the role of quality ambassador, actively contributing to raising awareness and promoting the adoption of QMS among their colleagues, particularly among younger and less experienced professionals. Women, on the other hand,

associated QMS more strongly with workload reduction (OR = 1.64) and time reduction (OR = 1.89). They may play a key role in changing male perceptions by demonstrating that these systems improve operational efficiency and foster a more equitable and collaborative organizational environment. This interaction has the potential to strengthen collective commitment and accelerate the implementation of such initiatives. On the other hand, although biologists were reluctant to implement QMS quickly (OR = 0.34), this reservation could depend on their fear that QMS would compromise the flexibility of their working methods and increase administrative load. Finally, professionals with over ten years' experience, who strongly supported workload reduction (OR = 3.19), emerged as facilitators to guide novice practitioners in QMS integration, highlighting a potential for mentoring initiatives.

This study has enriched our understanding of socio-demographic influences on QMS perceptions, facilitating the creation of targeted training programs to clarify QMS objectives and their positive impacts on quality outcomes and patient safety [42]. Appropriate training can not only enhance practitioners' technical skills, but also strengthen their commitment to the QMS, fostering a culture of continuous improvement [21].

The results of this study highlighted crucial practical implications for overcoming the obstacles associated with QMS adoption by MLP in Morocco. As a first step, the development of customized continuing education programs should be based on specialized modules, such as change management, the use of quality tools, and project management, to adequately address the diverse needs of laboratories. These educational initiatives could incorporate successful case studies from Morocco to demonstrate the tangible benefits of the QMS. In addition, to alleviate financial constraints, innovative strategies, including public-private partnerships, targeted government subsidies, and resource-sharing strategies, should be considered. For example, financial resources could be earmarked for the acquisition of digital technologies essential to the progressive, cost-effective automation of key processes. In addition, particular emphasis needs to be placed on resolving cultural and institutional challenges. This requires raising staff awareness of the benefits of the QMS while streamlining bureaucratic processes to reduce organizational resistance. Establishing robust organizational frameworks may require efficient allocation of human and material resources, accompanied by clearly defined performance indicators, such as reduced error rates, patient satisfaction, and improved compliance with international standards. These strategies, specifically adapted to the Moroccan environment, could optimize benefits while mitigating perceived obstacles to QMS implementation.

Despite the methodological rigor employed, this study involved some limitations that must be taken into account. The study narrowly focused on MLP perceptions of QMS, omitting practices and knowledge, and the sample size was not sufficiently representative for biologists to draw

generalizable conclusions from the results. Furthermore, relying primarily on self-assessments may introduce social desirability biases, while neglecting crucial variables, such as laboratory accreditation status and the nature of continuing education programs, which could have a significant impact on QMS perceptions.

CONCLUSION

This research has study highlighted notable gaps in awareness and perceptions of QMS among MLPs in Morocco. Despite general recognition of the benefits of QMS, such as increased efficiency, enhanced laboratory reputation, and improved professional skills, obstacles have been found to persist, particularly in terms of workload, financial implications, and the time required to implement QMS. These findings underline the importance of targeted measures, including customized continuing education initiatives designed to meet the specific requirements of various professional groups, to strengthen their commitment to QMS implementation. In addition, it is imperative to support laboratories in establishing a robust organizational framework, characterized by optimal resource management, to facilitate QMS integration. This may include task optimization, judicious resource allocation, and automation of repetitive processes. Such initiatives can simplify the QMS adoption process and reduce the perceived workload.

AUTHORS' CONTRIBUTION

M.E.: Drafted the manuscript, designed the study, and conducted data collection; H.G.: Drafted the manuscript, designed the study, and analyzed the findings; H.E.O. and K.E.M.: Contributed to methodology, analysis, and validation; M.A., Y.E.A., A.K., and A.E.O.: Reviewed and edited the manuscript; E.B.: Conceptualized the study, developed the methodology, validated the results, and supervised the project. All authors have reviewed and approved the final manuscript.

LIST OF ABBREVIATIONS

ML	=	Medical laboratory
MLP	=	Medical laboratory practitioner
QMS	=	Quality management system

ETHICAL STATEMENT

Our study on the perceptions of practitioners in medical analysis laboratories was non-interventional, aimed at gathering information on the opinions of healthcare professionals without altering their behavior or directly intervening in their activities. Thus, no formal ethical approval was sought. However, all moral considerations were rigorously respected: informed consent from participants was obtained, and the confidentiality of data and the anonymity of respondents were guaranteed. These aspects were clearly explained in the questionnaire used for our survey, ensuring the study's ethical and transparent conduct.

CONSENT FOR PUBLICATION

Informed consent was obtained from all participants by ensuring that they were fully aware of the purpose of the study before agreeing to take part.

STANDARDS OF REPORTING

STROBE guidelines were followed.

AVAILABILITY OF DATA AND MATERIALS

The data underpinning the findings of this article can be obtained upon request from the corresponding author [M.E].

FUNDING

None.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

ACKNOWLEDGEMENTS

The authors would like to express their gratitude for the support and collaboration of biologists, medical laboratory technicians, associations of laboratory professionals, and colleagues, whose contributions were indispensable to the realization of this study.

REFERENCES

- [1] Parija SC. Quality management system in diagnostic microbiology. In: Parija SC, Ed. *Textbook of Microbiology and Immunology*. Singapore: Springer Nature 2023; pp. 1079-81. http://dx.doi.org/10.1007/978-981-19-3315-8_72
- [2] Mesganaw B, Fenta A, Hibstu Z, Belew H, Misganaw K, Belayneh M. Medical laboratories quality management and challenges in ethiopia: A systematic review. *Pathol Lab Med Int* 2023; 15: 13-26. <http://dx.doi.org/10.2147/PLMI.S395895>
- [3] Lathro HD, Sudrié-Arnaud B, Snanoudj-Verber S, Tebani A, Bekri S. A simple approach to create a common language, a necessary element for the development of a quality culture in a medical biology laboratory. *Ann Biol Clin* 2021; 79(1): 83-7. <http://dx.doi.org/10.1684/abc.2021.1617> PMID: 33563586
- [4] Yao K, McKinney B, Murphy A, *et al.* Improving quality management systems of laboratories in developing countries: An innovative training approach to accelerate laboratory accreditation. *Am J Clin Pathol* 2010; 134(3): 401-9. <http://dx.doi.org/10.1309/AJCPNBBL53FWUIQJ> PMID: 20716796
- [5] Avellan T. A practical experience of accreditation in liberal multi-purpose multi-sites LBM. *RFL* 2010; 2010: 69-73. [http://dx.doi.org/10.1016/S1773-035X\(10\)70387-7](http://dx.doi.org/10.1016/S1773-035X(10)70387-7)
- [6] Reifenberg J-M, Riout E, Leroy A. Metrology in a biomedical laboratory: issues and challenges. *RFL* 2014; 2014: 69-76. [http://dx.doi.org/10.1016/S1773-035X\(14\)72447-5](http://dx.doi.org/10.1016/S1773-035X(14)72447-5)
- [7] Alqarani A, Data D, Algamdi A. Implementation of a quality system in the hospital environment: Application of ISO 17025 standard. preprint 2024. <http://dx.doi.org/10.31219/osf.io/jmknb>
- [8] Pillai S, Calvert J, Fox E. Practical considerations for laboratories: Implementing a holistic quality management system. *Front Bioeng Biotechnol* 2022; 10: 1040103. <http://dx.doi.org/10.3389/fbioe.2022.1040103> PMID: 36406233
- [9] Ingole N, Mathure T, Jinwal M, Kashyap P, Talwadekar S, Nataraj G. Role of Quality Management System in Setting up and Sustaining a Molecular Diagnostic Laboratory during COVID-19

- Pandemic. *NJLM* 2022.
<http://dx.doi.org/10.7860/NJLM/2022/50683.2560>
- [10] Eve A, Sprimont PA. Perceptions and attitudes related to the ISO 9001 standard: An analysis among operational employees. *Accounting Control Audit* 2016; 22(1): 27-52.
<http://dx.doi.org/10.3917/cca.221.0027>
- [11] Carey RB, Bhattacharyya S, Kehl SC, *et al.* Practical guidance for clinical microbiology laboratories: Implementing a quality management system in the medical microbiology laboratory. *Clin Microbiol Rev* 2018; 31(3): e00062-17.
<http://dx.doi.org/10.1128/CMR.00062-17> PMID: 29720490
- [12] Silaen S. Basic laboratory management training for institutions. *MOVE J Community Serv Engagem* 2023; 2(5): 140-5.
<http://dx.doi.org/10.54408/move.v2i5.184>
- [13] Zaid NA, Mohd Yusof M. An evaluation of a training management system adoption in a public sector: A case study. *Asia-Pac J Inf Technol Multimed* 2022; 11(2): 18-39.
<http://dx.doi.org/10.17576/apjitm-2022-1102-02>
- [14] Donovan G, Ong SK, Song S, *et al.* Remote mentorship using video conferencing as an effective tool to strengthen laboratory quality management in clinical laboratories: Lessons from Cambodia. *Glob Health Sci Pract* 2020; 8(4): 689-98.
<http://dx.doi.org/10.9745/GHSP-D-20-00128> PMID: 33361236
- [15] Tan KB, Thamboo TP, Lim YC. Continuing education for pathology laboratory technologists: A needs analysis in a Singapore teaching hospital. *J Clin Pathol* 2007; 60(11): 1273-6.
<http://dx.doi.org/10.1136/jcp.2006.045195> PMID: 17307865
- [16] Kleymann-Hilmes J, Brünschwitz S, Müller M. Quality Assurance in Medical Laboratories - An Indispensable Task with Benefits and Risks. *Federal Health Gazette health research health protection* 2022; 65(3): 327-34.
<http://dx.doi.org/10.1007/s00103-022-03502-5> PMID: 35166860
- [17] Zima T. Accreditation of medical laboratories - System, process, benefits for labs. *J Med Biochem* 2017; 36(3): 231-7.
<http://dx.doi.org/10.1515/jomb-2017-0025> PMID: 30568539
- [18] Allen LC. Role of a quality management system in improving patient safety - Laboratory aspects. *Clin Biochem* 2013; 46(13-14): 1187-93.
<http://dx.doi.org/10.1016/j.clinbiochem.2013.04.028> PMID: 23648455
- [19] Washetine K, Long É, Hofman V, *et al.* Accreditation according to the ISO 15189 standard of a pathology and somatic genetics laboratory (LPCE, CHU de Nice): Feedback. *Ann Pathol* 2013; 33(6): 386-97.
<http://dx.doi.org/10.1016/j.annpat.2013.10.002> PMID: 24331720
- [20] Lulie AD, Hiwotu TM, Mulugeta A, *et al.* Perceptions and attitudes toward SLMTA amongst laboratory and hospital professionals in Ethiopia. *Afr J Lab Med* 2014; 3(2): 233.
<http://dx.doi.org/10.4102/ajlm.v3i2.233> PMID: 29043195
- [21] Cordelia Enyanwu O. Quality management of the pre-analytical phase errors: Monitoring and way forward. *Texila Int J Public Health* 2023; 11(2): 183-94.
<http://dx.doi.org/10.21522/TIJPH.2013.11.02.Art019>
- [22] Burnat P, Payen C, Mérens A, Ceppa F, Renard C. Cooperations between biology laboratories of the establishments of healthcare. *Ann Biol Clin* 2013; 71(4): 419-28.
<http://dx.doi.org/10.1684/abc.2013.0824> PMID: 23906569
- [23] Vianna ELF, de Figueiredo VV, da Silva CMF, Bertolino LC, Spinelli L. Impact of implementing quality control systems in laboratories associated with teaching and research institutions - The case study of the laboratory for macromolecules and colloids in the petroleum industry. *Int J Metrol Qual Eng* 2022; 13: 4.
<http://dx.doi.org/10.1051/ijmqe/2022004>
- [24] Jayamani J, Biochemist C, Open Access PHC. Medical laboratory quality management: Current scenario and challenges in developing nation. *IOMC* 2022; 12: 5-6.
<http://dx.doi.org/10.4172/2167-1079.22.12.1.1000424.24>
- [25] Beyanga M, Gerwing-Adima L, Jackson K, *et al.* Implementation of the laboratory quality management system (ISO 15189): Experience from Bugando Medical Centre Clinical Laboratory - Mwanza, Tanzania. *Afr J Lab Med* 2018; 7(1): 657.
<http://dx.doi.org/10.4102/ajlm.v7i1.657> PMID: 30167386
- [26] Mateta P, Procop GW, Mtotela W, Nyakuwocha R, Fine G. Implementing laboratory quality management in Africa and central Asia: A model for healthcare improvement. *Trans R Soc Trop Med Hyg* 2022; 116(11): 1077-81.
<http://dx.doi.org/10.1093/trstmh/trac062> PMID: 35793199
- [27] Skrivankova VW, Richmond RC, Woolf BAR, Yarmolinsky J. STROBE Statement - checklist of items that should be included in reports of observational studies1 (© STROBE Initiative). *Int J Public Health* 2008; 53(1): 3-4.
<http://dx.doi.org/10.1007/s00038-007-0239-9> PMID: 18522360
- [28] Ministry of Health and Social Protection. Health map - Situation of health care provision 2023. (Accessed September 23, 2024)
- [29] Caduco DDD. Knowledge, attitude, and practices on laboratory quality assurance among medical technologists in selected level III hospitals in Davao City. *Int J Prog Res Sci Eng* 2021; 2(8): 398-427.
- [30] Azhar K. Knowledge, Attitude and Practice of Quality Assurance Among Medical Laboratory Technologists Working in Labora 2012; p. 6.
- [31] Dargahi H, Rezaian M. Correlation between Knowledge, Attitude and Performance of the Employees with Quality Assurance System Implementation by the Employers 2007; p. 36.
- [32] Girma M, Desale A, Hassen F, Sisay A, Tsegaye A. Survey-defined and interview-elicited challenges that faced Ethiopian Government Hospital Laboratories as they applied ISO 15189 accreditation standards in resource-constrained settings in 2017. *Am J Clin Pathol* 2018; 150: 303-9.
<http://dx.doi.org/10.1093/AJCP/AQY049>
- [33] Ho B, Ho E. The most common nonconformities encountered during the assessments of medical laboratories in Hong Kong using ISO 15189 as accreditation criteria. *Biochem Med* 2012; 22(2): 247-57.
<http://dx.doi.org/10.11613/BM.2012.027> PMID: 22838190
- [34] Ravaghi H, Abolhassani N. Comparison of laboratories directors' and assessors' opinions on challenges and solutions of standardization in Iran: A qualitative study. *Glob J Health Sci* 2015; 7(4): 358-66.
<http://dx.doi.org/10.5539/gjhs.v7n4p358> PMID: 25946940
- [35] Lapić I, Ivić M, Alpeza Viman I, *et al.* Laboratory professionals' attitudes towards ISO 15189 2012 accreditation: An anonymous survey of three Croatian accredited medical laboratories. *Biochem Med* 2021; 31(2): 331-41.
<http://dx.doi.org/10.11613/BM.2021.020712> PMID: 34140835
- [36] McGrowder D, Tucker D, Miller FG, Anderson M, Vaz KA, Anderson-Jackson L. Accreditation of medical laboratories: Challenges and opportunities. *Handbook of Research on Modern Educational Technologies, Applications, and Management*. IGI Global 2020; 2: pp. : 600-16.
<http://dx.doi.org/10.4018/978-1-7998-3476-2.ch037>
- [37] Valdivieso-Gómez V, Aguilar-Quesada R. Quality management systems for laboratories and external quality assurance programs. In: Zaman GS, Ed. *Quality Control in Laboratory*. InTech 2018.
<http://dx.doi.org/10.5772/intechopen.73052>
- [38] Natarajan D. Implementing QMS with ERP software. In: Natarajan D, Ed. *ISO 9001 Quality Management Systems*. Cham: Springer International Publishing 2017; pp. 129-37.
http://dx.doi.org/10.1007/978-3-319-54383-3_7
- [39] Rihm SD, Tan YR, Ang W, *et al.* The digital lab manager: Automating research support. *SLAS Technol* 2024; 29(3): 100135.
<http://dx.doi.org/10.1016/j.slast.2024.100135> PMID: 38703999
- [40] Zhang C, Ji X, Wei J, Dou X, Chen D, Zhang X. Improving regional medical laboratory center report quality through a report recall management system. *Clin Chem Lab Med* 2024; 62(2): 341-52.
<http://dx.doi.org/10.1515/cclm-2023-0786> PMID: 37673465
- [41] Shang X, Zhao F, Du J, *et al.* Development and clinical evaluation of an online automated quality control system for improving laboratory quality management. *Clin Chim Acta* 2023; 541: 117240.

<http://dx.doi.org/10.1016/j.cca.2023.117240> PMID: 36736683
[42] Bouhsane D, Bernous N, Mokrane R, *et al.* Mastering the

analytical process of the complete blood count: How and why?
Ann Biol Clin 2020; 78(1): 79-86.
<http://dx.doi.org/10.1684/abc.2020.1516> PMID: 32108585