Review Article

Relationship Among Job Market, Higher Education and Professionals in the Clinical Analysis Area in Brazil

Maria Elizabeth Menezes[1], Paulo Roberto Boff[2], Flávia Martinello[3*]

[1] Pharmacist; PhD in Microbiology, President of the Brazilian Society of Clinical Analysis (SBAC).
[2] Pharmacist; PhD in Pharmaceutical Policy and Services, Member of the Temporary Technical-Scientific Committee for Structuring the National Laboratory Diagnostic Policy (Clinical, Toxicological, and Environmental Analysis) in the Context of Healthcare.
[3] Pharmacist; PhD in Clinical Analysis; Professor at Department of Clinical Analysis, Federal University of Santa Catarina (UFSC).

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[*] **Corresponding Author:**

Flávia Martinello
Department of Clinical Analyses, Federal University of Santa Catarina, 1240 Delfino Conti st, Florianópolis, Santa Catarina 88040-370, Brazil.
Email: flavia.martinello@ufsc.br

ABSTRACT

Clinical analysis, as the laboratory medicine area is known in Brazil, plays a strategic role in healthcare in the country, supporting diagnosis, therapeutic monitoring, and epidemiological surveillance. This article aims to analyse the relationship among the job market, higher education, and clinical analysis professionals in Brazil. Despite a vast network of 28,000 laboratories, the sector faces challenges such as outdated test remuneration, regional inequalities, and a shortage of qualified professionals. The COVID-19 pandemic highlighted these weaknesses but also accelerated regulatory advances, including pharmacy-based testing. Professional training is fragmented, with pharmacists, biomedical scientists, biologists, and clinical pathologists contributing differently to the area. However, heterogeneity in curricula, limited practical training, and the dominance of private higher education compromise quality. The Brazilian Society of Clinical Analysis (SBAC) promotes programs for knowledge, quality control, and accreditation, playing a vital role in expanding access and reducing inequalities. Future perspectives emphasize standardized curricula, improved laboratory training, innovation, and fairer career policies to attract and retain professionals. Strengthening collaboration among universities, professional societies, and health institutions is crucial to align education with national healthcare needs.

Keywords: Brazil; Laboratory medicine; Clinical analysis; Healthcare workforce; Professional training; Higher education; Brazilian Society of Clinical Analysis (SBAC)

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Introduction

Although lacking due recognition from the public and, often, from other healthcare professionals, clinical analysis represents a strategic sector for healthcare, given its importance in diagnosis, therapeutic monitoring, and epidemiological surveillance. In Brazil, despite a broad network of laboratories throughout the country, the sector faces structural challenges involving a shortage and low pay for qualified professionals, a historical gap in payment mechanisms for tests, fragmented academic training, and unequal regional access to services (1). The expansion of higher education in healthcare, intensified since the 1990s and marked by the predominance of private institutions, has brought advances in terms of reach, but has also generated heterogeneity in training and compromised educational quality. In this context, analysing the interaction among the market, vocational education, and professionals becomes essential to understanding current dilemmas and designing solutions that align education, professional practice, and the growing demands of the Brazilian laboratory diagnostics sector (2).

The aim of this article is to analyse the relationship among the job market, higher education, and clinical analysis professionals in Brazil.

The Clinical Analysis Market in Brazil

Brazil has approximately 28,000 laboratories serving a population of approximately 213 million (3). Despite the sector's growth, the remuneration for tests is outdated, having not been adjusted for 25 years. In response to this scenario, to reduce test costs, market models based on the centralization of tests in technology parks emerged, while many laboratories began to act as biological sample collection centres. At the same time, associative networks of laboratories focused on joint purchasing emerged. These initiatives, in addition to reducing costs, have prevented the lack of laboratory services, unemployment, and, at the same time, regional inequality in access to diagnostics. However, the expansion of services has been accompanied by a shortage of qualified professionals.

During the COVID-19 pandemic, the sector grew by 15%, but revealed a shortage of specialized labor, especially for performing molecular analyses of SARS-CoV-2. On the other hand, this period spurred the regularization of testing outside of laboratory settings, such as in pharmacies (4).

Although Brazilian regulations impose strict requirements for the operation of clinical laboratories, accreditation is not yet mandatory, unlike in some other countries. Brazil, however, has national accreditation standards based on ISO 15189:2022, notably the National Accreditation System (SNA-DICQ), which has already accredited more than 500 laboratories out of just over 700 in the country (5).

This panorama highlights the need to strengthen not only laboratory quality but also the training of professionals trained in quality management from undergraduate studies onwards, in order to align diagnostic practices with international standards of excellence.

Training

Professionals Qualified to Work in Clinical Analysis in Brazil

The enactment of the Brazilian Education Guidelines and Bases Law No. 9,394/1996 boosted the expansion of higher education in the country, but accentuated the heterogeneity of training and the commercialization of education. In the healthcare field, these transformations directly impacted the area of clinical analysis, resulting in fragmented curricula, regional asymmetries, and, more recently, the permission to offer blended courses in Pharmacy, Biomedicine, and Biology, which raises concerns about the quality of clinical training (6). Currently, four professional categories are qualified to work in the sector:

- Pharmacists: Historical protagonists of clinical analysis. Until 2002, Pharmacy graduates could obtain specific qualifications in clinical analysis. From that date on, pharmaceutical training became mandatory, albeit in a limited format, which diminished the interest of many students in the area (7).
- Biomedical scientists: These professionals became established in the 2000s, with curricula focused on laboratory analysis and biotechnology. However, the rapid expansion of private programs, many of them in a blended format, has compromised the quality of training.
- Biologists: Their inclusion in the sector is limited, dependent on specific qualifications and additional training, with a greater presence in environmental analysis.
- Clinical pathologists: After graduating from Medicine, they must complete a residency in Clinical Pathology/Laboratory Medicine. Their training integrates clinical and laboratory diagnosis, but the specialty has low appeal among physicians, constituting a small group concentrated in more complex laboratories (8).

Table 1 presents, in a systematic manner, the core elements that characterize each of the professional categories qualified to work in clinical analysis. Highlighted are the degree of emphasis placed on clinical analysis in the curricula, the predominant profiles for insertion in the sector, and, finally, the main critical points associated with training and professional practice in clinical analysis. This summary allows for a comparative view of the convergences and disparities between the different career paths, providing support for analysing the adequacy of training to the current and

Table 1. Summary of the educational and professional characteristics of the careers qualified to work in clinical analysis in Brazil.

Profession	Emphasis of Training for Clinical Analysis	Profile in the Sector	Current Critical Issues
Pharmacy (Pharmacists)	Clinical and technological training	Traditionally the largest professional category in the sector; wide integration into public and private laboratories	Reduction of clinical analysis content; heterogeneity of training; declining student interest
Biomedicine (Biomedical Scientists)	Emphasis on laboratory analysis, biotechnology, imaging exams and aesthetics	Expanding role since the 2000s; greater integration into private laboratories	Excess of private courses; uneven quality; weakness in practical training
Biology (Biologists)	Training in biology with the possibility of a specialization in clinical analysis through professional council regulation	Restricted integration, in specific regions and niches	Unfocused training; need for additional training through internships and postgraduate studies
Medicine (Clinical Pathologists)	Emphasis on the clinical-laboratory interface and integrated diagnosis	Restricted and specialized integration, commonly in more complex analyses	Reduced number of professionals; low appeal of the specialty; limited involvement in the routine of low-complexity exams

future demands of the clinical analysis job market.

Quantitative Overview

Brazil's higher education in healthcare has a strong private sector presence. By 2023, the country had approximately 700 Pharmacy programs, 90% of which were offered by private institutions, placing it among the largest in terms of number of offerings (9).

Biomedicine also has a significant presence, with 412 programs registered in 2021. Biology programs with a specialization in clinical analysis and medical residencies in Clinical Pathology are less well documented, lacking consolidated data (10).

The Role of the Brazilian Society of Clinical Analysis (SBAC) in Professional Training

The Brazilian Society of Clinical Analysis (SBAC) is a non-profit scientific organization recognized nationally and internationally for its contribution to the promotion of knowledge, innovation, and quality in laboratory diagnostics (11). Its mission is to foster professional training through courses, conferences, technical assistance, and programs aimed at strengthening small and medium-sized laboratories. Notable among its initiatives are the National Quality Control Program (PNCQ), which offers Internal Quality Control and Benchmarking Program for laboratory performance indicators, bringing together approximately 6,000 participating laboratories; and the National Accreditation System (SNA-DICQ), mentioned above, which establishes standards of excellence and ensures compliance with international standards (12). The SBAC's relevance is also evidenced by the leading role of its associated laboratories in the Unified Health System (SUS), responsible for approximately 50% of the tests performed annually in the country. This broad reach contributes decisively to reducing regional inequalities and expanding the population's access to diagnostic services.

Training Challenges

The training of professionals working in clinical analysis in Brazil faces multiple challenges, stemming from both structural issues in higher education and changes in the job market.

Another recurring obstacle is insufficient laboratory practice throughout undergraduate studies, as a significant portion of institutions lack adequate infrastructure and properly equipped university laboratories. This deficit compromises the consolidation of essential technical skills and reduces the integration of future professionals with the Unified Health System (SUS), limiting practical experience in real-world settings. Finally, the sector faces low attractiveness due to declining wages (13).

Perspectives and Recommendations

Establishing a minimum curriculum, with defined theoretical and practical hours, in each area of clinical analysis is essential to align professional profiles with the sector's demands. There is a need for training in emerging competencies, including innovation, quality management, and health data analysis, as advances in laboratory diagnostics demand professionals capable of working in increasingly automated and interdisciplinary environments (14).

Strengthening laboratory practice during undergraduate studies is essential, with well-equipped university laboratories and high-quality supervised internships. Furthermore, professional development policies—such as stable careers, fair compensation, and residency programs—are necessary to attract and retain qualified professionals.

All these improvements in the training and continuing education of professionals indicate a growing demand for initiatives by scientific societies in the area of clinical analysis.

Conclusion

The clinical analysis sector in Brazil faces a paradox: although strategic to public health, with a vast network of laboratories, it faces complex structural challenges. Overcoming these dilemmas requires collaboration among the public and private sectors,

educational institutions, and scientific societies. It is urgent to reformulate curricula and value professionals, recognizing the fundamental role of clinical analysis in diagnosis and comprehensive health care. Without integrated educational and regulatory policies, the current model perpetuates gaps in training and a mismatch among education, the market, and the needs of the Brazilian Unified Health System.

Author Contribution

All authors contributed to the study design, conception, and manuscript creation, and have reviewed and approved the final version of the manuscript.

Conflict of Interest

The authors declared that they have no conflict of interest.

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