Revista Española de Educación Médica

Free postgraduate training in laboratory medicine: evolution of the experience in virtual courses for the emergency.

Formación de posgrado gratuita en medicina de laboratorio: evolución de la experiencia en cursos virtuales para la urgencia.

Carolina Alejandra Vaccino[1], Noelia Vallejos Rojas [2,] Analía Gonzalez Acosta [3] *

Parmenio Piñero General Hospital, City of Buenos Aires, Argentina.
[1] carolinavaccino@gmail.com ; [2] noeliavallejos.r@gmail.com, [3] Parmenio Piñero General Hospital, City of Buenos Aires; José de San Martín Clinical Hospital, Faculty of Pharmacy and Biochemistry, University of Buenos Aires, Argentina, dra.agonzalezacosta@gmail.com

* Correspondence: dra.agonzalezacosta@gmail.com

Received: 21/9/26; Accepted: 20/10/26; Published: 22/10/26

Summary.

Aim: To describe the experience of a free, synchronous, online postgraduate course for biochemists and emergency clinical laboratory technicians, and to analyze the evolution of the participant profile, their perception of the course, and quality indicators across four cohorts (2023–2026). **Methods:** An observational study was conducted, combining follow-up of 377 enrollments with a repeated satisfaction survey (Google Forms), sent with the certificate of completion and answered by those who finished the course (n=142; cohorts 2023–2025). The association between course completion and profession, work sector (public vs. private), jurisdiction, and emergency department experience was assessed using the chi-square test or Fisher's exact test with Benjamini-Hochberg (FDR) correction. Perception indicators (Likert scale 1–5) were analyzed using the Mann-Whitney, Kruskal-Wallis, Spearman, and Wilcoxon signed-rank tests for paired samples. **Results:** Completion rates were 45.3% (2023), 55.4% (2024), 60.2% (2025), and 60.2% (2026), with no significant differences between cohorts. Completion was associated with the work sector (public 60.1% vs. private 36.9%), but not with profession, jurisdiction, or emergency department experience. 23.3% of registered participants did not attend any classes, and 20.7% started the course but did not complete it. The course was perceived highly and consistently (perceived usefulness 4.6–4.8/5), with no differences by profile or changes among those who responded in more than one cohort. Technicians and those without emergency department experience more frequently reported that the course exceeded their expectations. 29.8% re-enrolled in subsequent editions, with higher re-enrollment rates among those who completed the course (48-64%) than among those who did not complete or start it (4-24%). **Conclusions:** Satisfaction with this free postgraduate course was high, consistent across all participants, and remained high throughout all editions. Completion rates differed significantly depending on the work sector, suggesting that, in addition to the free tuition, other factors influence the likelihood of completing continuing education.

Keywords: postgraduate education, continuing education, emergency biochemistry, laboratory medicine.

Resumen.

Objetivo: Describir la experiencia de un curso de posgrado virtual, sincrónico y gratuito para bioquímicos/as y técnicos/as de laboratorio clínico de urgencias, y analizar la evolución del perfil de participantes, su percepción del curso e indicadores de calidad a lo largo de cuatro cohortes (2023-

2026). **Métodos:** Estudio observacional que combinó el seguimiento de 377 inscripciones con una encuesta de satisfacción repetida (Google Forms), enviada con el certificado de aprobación y respondida por quienes finalizaron (n=142; cohortes 2023-2025). Se evaluó la asociación entre la finalización y la profesión, el sector de trabajo (público vs. no público), la jurisdicción y la experiencia en urgencias mediante chi-cuadrado o test exacto de Fisher, con corrección de Benjamini-Hochberg (FDR). Los indicadores de percepción (escala Likert 1-5) se analizaron con los tests de Mann-Whitney, Kruskal-Wallis, Spearman y Wilcoxon para muestras pareadas. **Resultados:** La finalización fue de 45,3% (2023), 55,4% (2024), 60,2% (2025) y 60,2% (2026), sin diferencias significativas entre cohortes. Se asoció con el sector de trabajo (público 60,1% vs. no público 36,9%), pero no con la profesión, la jurisdicción ni la experiencia en urgencias. El 23,3% de las inscripciones no llegó a asistir a ninguna clase y el 20,7% inició la cursada sin completarla. La percepción del curso fue alta y estable (utilidad percibida 4,6-4,8/5), sin diferencias por perfil ni cambios entre quienes respondieron en más de una cohorte. Los/as técnicos/as y quienes no tenían experiencia en urgencias reportaron con más frecuencia que el curso superó sus expectativas. El 29,8% se reinscribió en ediciones posteriores, con mayor reinscripción entre quienes completaron el curso (48-64%) que entre quienes no lo completaron o no lo iniciaron (4-24%). **Conclusiones:** La satisfacción con este curso de posgrado gratuito fue alta, homogénea entre perfiles y sostenida en todas las ediciones. La finalización difirió significativamente según el sector de trabajo, lo que sugiere que, además de la gratuidad, intervienen otros factores en la posibilidad de completar la formación continua.

Palabras clave: educación de posgrado, formación continua, bioquímica de urgencias, medicina de laboratorio.

1. Introduction

Clinical biochemistry and laboratory medicine are constantly evolving disciplines, and many of the critical topics for the daily work of the emergency laboratory—where response time and the correct interpretation of results directly impact clinical decision-making—require in-depth study that exceeds the scope of undergraduate training (1, 2). In Argentina, there are various continuing education programs offered in different formats: (face-to-face, synchronous and asynchronous online, paid and free, and of varying durations), provided by academic, professional, and government institutions.

In this context, the Ministry of Health of the City of Buenos Aires promotes a training program through free courses led by professionals with relevant experience who design the pedagogical proposals on a voluntary and pro bono basis. The Emergency Laboratory Update Courses at Piñero Hospital began in 2023 with the aim of providing postgraduate training for biochemists and technicians, with content tailored to their needs and designed to address dilemmas and problems encountered in professional practice. These professionals and technicians work together daily in the emergency laboratory and complement each other, which motivates the development of a joint continuing education program that takes into account this inherent diversity.

The objective of this work was to describe the experience of the postgraduate course, which is virtual, synchronous and free, aimed at biochemists and emergency laboratory technicians, over four cohorts (2023-2026); to analyze the evolution of their profile and their perception of the course; to identify factors associated with completion and re-enrollment; and to explore, through qualitative analysis of open questions, the perceived reasons behind these patterns.

2. Methods

2.1 Design

This observational study combined three sources: (a) the administrative record of the 377 enrollments in the four cohorts of the course, with their final status classified into three categories: "passed" (met attendance and evaluation requirements), "dropped out" (attended at least one class but did not complete the course), and "did not attend" (did not attend any classes); (b) a repeated cross-sectional satisfaction and opinion survey, administered at the end of each 2023–2025 cohort, completed by those who finished the course; and (c) a retrospective, dynamic cohort-type follow-up of re-enrollment between editions, identifying each person by an internal number. Throughout the text, "finished" is equivalent to "passed" the course. The STROBE guidelines for reporting observational studies were followed (3).

2.2 Context

The "Emergency Laboratory Refresher Course" at Piñero Hospital, certified by the Ministry of Health of the City of Buenos Aires (4), provides points toward professional recertification. It is free and aimed at biochemists and laboratory technicians. It consists of bi-weekly synchronous theoretical and practical sessions with a 70% attendance requirement and asynchronous assessments, also requiring a 70% passing grade. The first edition was in 2023 with an initial enrollment of 75, which was increased to 100 starting in 2024. The platforms used in the various courses were Jitsi (8x8, 2023), Zoom (Zoom Video Communications, 2024-2025), and Microsoft Teams (Microsoft, 2026); in addition, Google Classroom (Google) was integrated for course management starting in 2024. Assessment activities were conducted using Google Forms questionnaires.

2.3 Participants

The 377 registrations recorded in the four cohorts were included (2023: n=75; 2024: n=101; 2025: n=98; 2026: n=103), corresponding to 262 unique participants.

2.4 Instrument and data collection

At the end of the 2023-2025 cohorts, a satisfaction survey was administered via Google Forms. The survey consisted of several questions: seven Likert-type items (1 to 5 scale) regarding perceived usefulness for work, the online format, organization, relevance of topics, teaching level, evaluation criteria, and platform performance; one categorical question about meeting expectations ("No" / "Yes" / "Exceeded expectations"); one multiple-choice question about topics of greatest interest, with no limit on the number of options; two open-ended questions about the main learning outcome of the course; general comments; and suggestions for future editions. A total of 142 responses were recorded (2023: n=33; 2024: n=50; 2025: n=59). Since the 2026 cohort survey had not yet been administered at the time of this study due to administrative issues, the perceptions of that cohort were not included in this analysis. The course syllabus is unique for each cohort, with no overlap between editions. Therefore, changes in satisfaction across cohorts should be interpreted as an evaluation of editions with different content, not as a repetition of the same program. Satisfaction survey responses were collected along with each participant's email address to link the response to their registration and enable analysis. For this analysis, the data were pseudonymized.

2.5 Variables

The following factors were analyzed: profession (biochemist/technician), work sector ("public" or "non-public," the latter grouping private and military/police sectors), geographic jurisdiction ("CABA" -City of Buenos Aires- or "outside CABA" -which includes Greater Buenos Aires and other provinces-), past or current work experience in on-call shifts (emergency room experience "Yes" or "No"), final status of each course ("passed," "dropped out," or "did not attend," according to the

definitions in section 2.1), and re-enrollment in subsequent cohorts. The records did not include the sex/gender variable, so it was not possible to analyze differences based on this dimension. Six registrations corresponded to people who were not practicing, and eight indicated a workplace that did not allow for the assignment of sector or jurisdiction; 368 and 366 registrations were analyzed for these variables, respectively. The categories "private" and "military/police" were grouped as "non-public" due to the small number of cases in the latter (n=11) and their empirical similarity: completion rates were 37.0% and 36.4%, respectively. This grouping is for operational purposes and does not imply that both sectors offer equivalent working conditions.

2.6 Statistical analysis

Categorical variables were compared using the chi-square test or Fisher's exact test (when any expected cell was less than 5), and ordinal variables (Likert items) were compared using the Mann-Whitney U test (two groups) or the Kruskal-Wallis test (more than two groups), as these ordinal data are not necessarily normally distributed. The correlation between perception items was estimated using Spearman's rank correlation coefficient. For those who responded to the satisfaction survey in more than one cohort, their first and last responses were compared using the Wilcoxon signed-rank test for paired samples, in order to explore whether the perception of the course changes within the same individual upon repeating it. The re-enrollment index (RI) of each cohort transition is defined as the proportion of people who, having completed the course (RI(F)) or not having completed it (RI(L)) in a cohort, re-enrolled in the following edition: RI(F) = re-enrolled in year t+1 / enrolled who finished in year t; RI(L) = re-enrolled in year t+1 / enrolled who did not complete the course, either because they dropped out or because they did not start it in year t. Given the number of comparisons performed within each hypothesis family (completion vs. profile: 5 tests—trends across cohorts, profession, sector, jurisdiction, and emergency room on-call experience; perception vs. profile: 24 tests; expectations vs. profile: 4 tests; paired change in re-enrollees: 6 tests; IR according to completion, by cohort transition: 3 tests; re-enrollment vs. profile: 4 tests), the Benjamini-Hochberg correction (FDR) was applied, and both uncorrected and corrected p-values (p_FDR) are reported. Comparisons between cohorts of the perception and expectations fulfillment items were performed using Kruskal-Wallis and chi-square tests, respectively, and are reported without correction because they are unique tests within each dimension. Additionally, to characterize the profile of registered participants, the composition of each cohort by profession, sector, area, and emergency department experience was compared against a null proportion of 0.5 using an exact binomial test (16 trials) with Benjamini-Hochberg (FDR) correction. A logistic regression model was also fitted for completion, including profession, sector, jurisdiction, emergency department on-call experience, and cohort as covariates. For comparisons of completion rates according to profile, in addition to the p-value, the effect size is reported using the odds ratio (OR) with its 95% confidence interval and Cramer's V. The analyses were performed using Python (pandas, scipy, statsmodels).

2.7 Qualitative Analysis

The responses to the open-ended questions (main learning, general comments and suggestions) were analyzed using inductive thematic content analysis: complete reading of the responses, identification of emerging categories and calculation of their frequency per cohort, without starting from a predefined category scheme.

2.8 Ethical aspects

This was a non-interventional observational study based on administrative course records and responses to a routine satisfaction survey administered as part of the quality assessment of the now-completed educational activity. Data were pseudonymized before analysis: names, email addresses, and identification numbers were replaced with an internal identifier necessary to link registrations and surveys across editions, and the correspondence key was kept secure by the course director. No

clinical or health data were collected from participants . The principles of the Declaration of Helsinki were respected. The protocol was submitted to the Research Ethics Committee of Hospital Piñero, which determined that, as it was not clinical research, it was exempt from review by the committee, although it recommended protecting the personal data of the respondents.

3. Results

3.1 Profile of registered individuals

In all four cohorts, the public sector and on-call experience were significantly predominant (p_FDR<0.001), and biochemists were more prevalent than technicians in all but 2024 (binomial test; 2023, 2025, and 2026: p_FDR<0.05; 2024: p_FDR=0.090). Only in 2023 were those working outside the City of Buenos Aires predominant (p_FDR=0.027), a difference that diminished thereafter (2024-2026: p_FDR>0.36). No variable changed significantly between years (all p_FDR>0.16). The profession was strongly associated with jurisdiction (76.1% of technicians worked outside of the City of Buenos Aires vs. 44.7% of biochemists, p<0.0001) and with experience in emergency settings (91.8% of biochemists had experience vs. 76.0% of technicians, p<0.0001), but not with the work sector (p=0.32). That is, the technicians come mostly from the Greater Buenos Aires area and other provinces, and have less experience in emergency rooms (Figure 1).

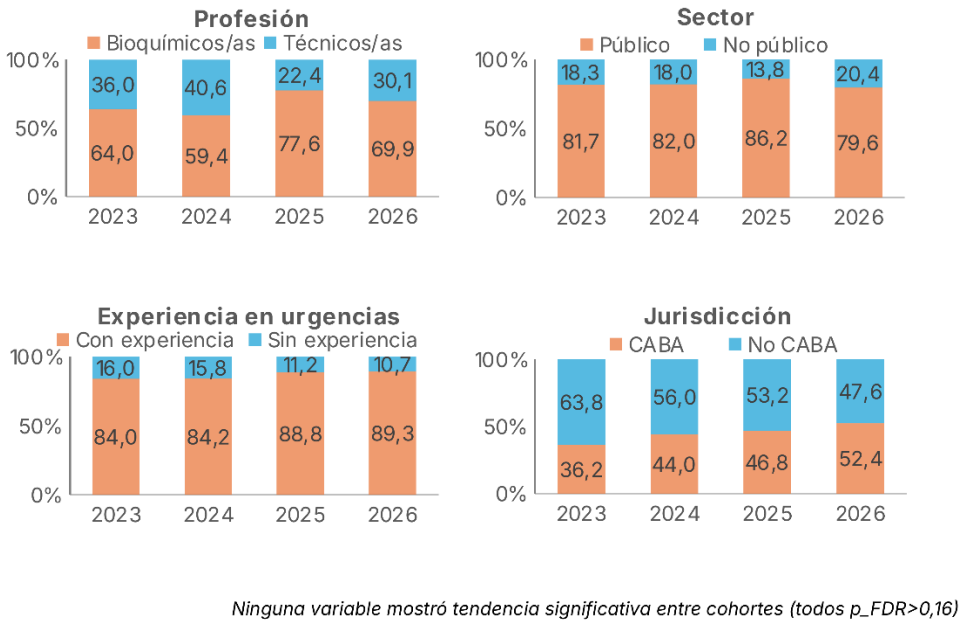

Figure 1. Profile of enrolled participants, by cohort. Percentage distribution by profession, employment sector, prior experience in emergency on-call shifts, and jurisdiction, across the four editions of the course (2023: n=75; 2024: n=101; 2025: n=98; 2026: n=103). Profession and prior experience were calculated based on the total number of enrollees in each cohort; sector and jurisdiction were calculated based on enrollees with a classifiable workplace (n=368 and n=366, respectively, across all four cohorts), as individuals who were not currently practicing and those for whom the data did not allow for categorization were excluded. CABA: Autonomous City of Buenos Aires.

3.2 Course Completion

The completion rate showed an increasing trend (45.3% (2023), 55.4% (2024), 60.2% (2025), and 60.2% (2026)) that did not reach statistical significance after correction for multiple comparisons (χ^2=4.9; p=0.178; p_FDR=0.297). Of the 377 total enrollments, 211 (56.0%) resulted in course completion. The remaining 166 were divided between those who attended some classes without completing the course (78; 20.7%) and those who did not attend any classes (88; 23.3%). Considering only the group of those who started the course (n=289), 73% completed it (Figure 2).

Table 1. Completion according to profile characteristics.

Variable		% Finished	N	p	p_FDR
Profession	Biochemists	59.0%	256	0.109	0.271
	Technicians	49.6%	121		
Sector	Public	60.1%	303	0.001	0.005
	Private	36.9%	65		
Jurisdiction	CABA	59.9%	167	0.244	0.305
	No CABA	53.3%	199		
Emergency room	Yeah	56.9%	327	0.447	0.447
	No	50.0%	50		

N varies depending on the data available for each variable. CABA, Autonomous City of Buenos Aires.

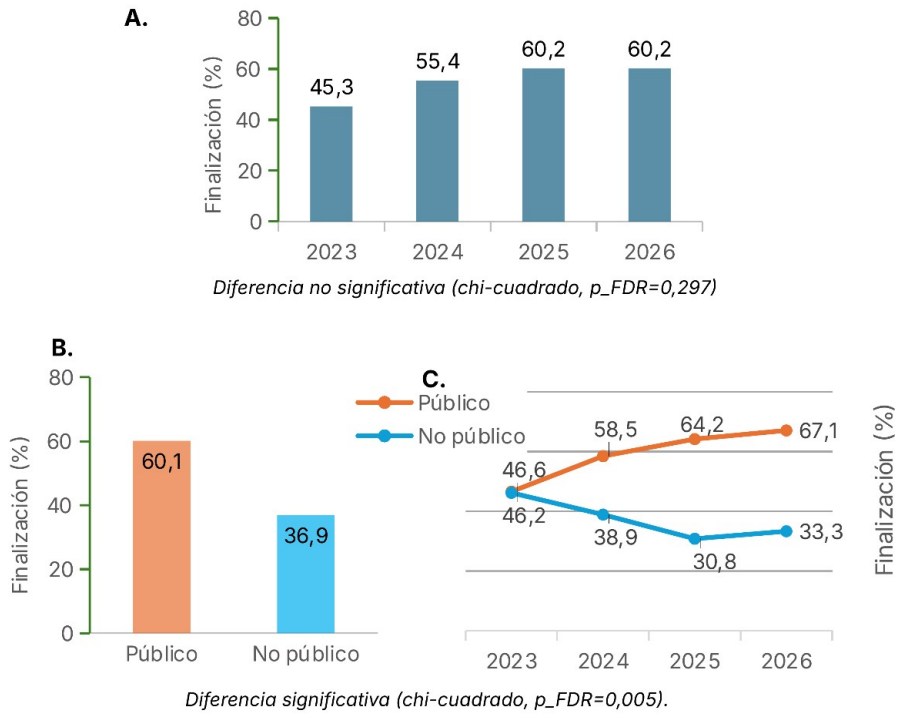

Figure 2. Course completion, by cohort and by employment sector. (A) Completion rate for each cohort (n=377). (B) Completion rate by employment sector, across all four cohorts (public: n=303; non-public: n=65; p_FDR=0.005). (C) Completion rate by employment sector within each cohort. The "non-public" category encompasses the private and military/police sectors.

Employment sector was the only variable significantly associated with completion after adjusting for FDR . The absolute difference was 23.2 percentage points (public 60.1% vs. non-public 36.9%; OR 2.57, 95% CI 1.48–4.47; Cramer's V 0.171). This result was supported by a cohort-adjusted logistic regression model (n = 366; overall model p = 0.010; sector: OR = 2.53, 95% CI 1.44–4.45). In other words, when simultaneously controlling for profession, jurisdiction, on-call experience, and cohort, working in the public sector was associated with approximately 2.5 times greater chances of completion than working in the non-public sector, and this association was not explained by the other variables in the model. When the results were broken down according to when the trajectory was interrupted, the difference by sector was observed both in those who did not start (20.5% in the public sector vs. 36.9% in the non-public sector; OR 0.44, 95% CI 0.25-0.78; p_FDR=0.029) and, less precisely, in those who did start (75.5% vs. 58.5%; OR 2.19, 95% CI 1.10-4.34; p_FDR=0.152). The effect size was similar in both components, so the design does not allow the gap to be attributed to only one of them.

3.3 Satisfaction and its evolution

The results in this section correspond exclusively to those who completed the course, as the survey was sent along with the certificate of completion. Overall satisfaction across all items was high and stable between 2023 and 2025: between 80.1% and 95.1% of responses rated each item 4 or 5 points (out of 5), with no significant differences between cohorts (p>0.19). Perceived usefulness for professional practice ranged from 4.59 to 4.76 out of 5 (Kruskal-Wallis, p=0.524). Only the perception of the platform used varied between cohorts: Jitsi (2023, mean=3.79) received worse evaluations than Zoom (2024, mean=4.38; p=0.013, Mann-Whitney) (Figure 3). The platform change after 2023 coincides with this improvement (consistent with the qualitative comments on technical issues in the first cohort, results shown below).

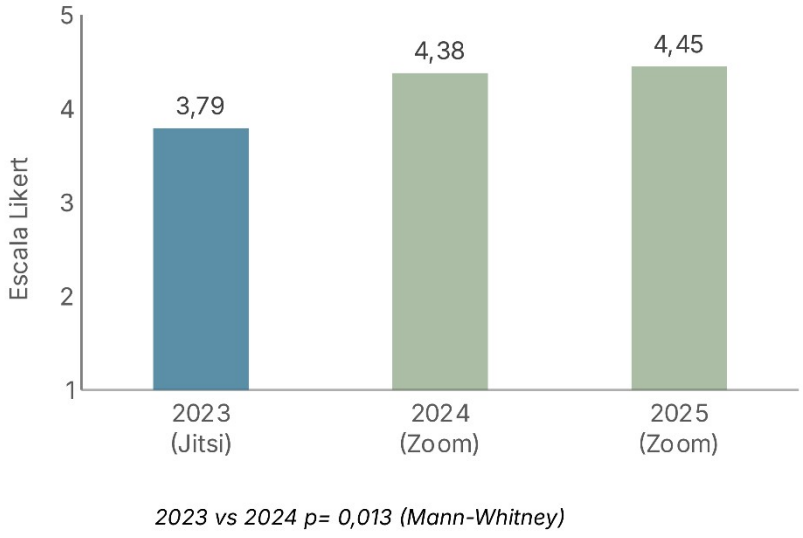

Figure 3. Evaluation of the videoconferencing platform, by cohort. Mean score on a 1–5 Likert scale assigned to Jitsi in 2023 (n=33), Zoom in 2024 (n=45), and Zoom in 2025 (n=55). The difference between 2023 and 2024 was statistically significant (p=0.013; Mann-Whitney test).

The perception items correlated strongly with each other (Spearman, rho 0.70–0.87), suggesting an overall assessment of quality rather than independent dimensions; perceived usefulness for work correlated weakly with the other items (rho 0.07–0.33) and constitutes a distinct dimension. Of the 24 comparisons between perception items and profile variables (profession, sector and jurisdiction of

work, experience in emergency medicine), none were significant after FDR correction (minimum p_FDR=0.16), indicating that the perception of the course was homogeneous across profiles. The item with the most marked difference by profession was perceived usefulness for work (Biochemists 4.59 vs. Technicians 4.81), although this too did not reach significance after correction (p=0.023 uncorrected; p_FDR=0.27).

3.4 Fulfillment of expectations

When asked if the course met their expectations, no participant responded negatively (Figure 4). Laboratory technicians exceeded their own expectations more frequently than biochemists (41.9% vs. 19.2%), as did those without experience in emergency room shifts compared to those with experience (50.0% vs. 22.6%). This perception was not associated with the work sector (Public 25.2% vs. Non-public 22.2%; p_FDR=1.000) or jurisdiction (CABA 19.0% vs. Non-CABA 29.7%; p_FDR=0.285), nor did it vary significantly between cohorts (2023: 24.2%; 2024: 26.0%; 2025: 27.1%; χ^2=0.09; p=0.956).

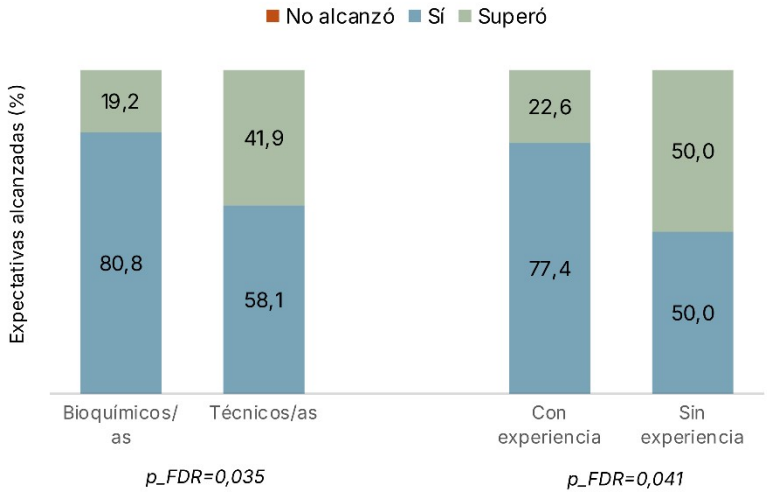

Figure 4. Compliance with expectations, according to profession and previous experience in emergency guards. Percentage distribution of the responses ("Not enough" / "Yes" / "Exceeded expectations") among those who responded to the survey (n=142): biochemists n=99 and technicians n=43; with previous experience n=124 and without experience n=18. No participant responded that the course did not meet their expectations. Benjamini-Hochberg (FDR) corrected p values.

3.5 Re-registration

Of the 262 participants, 29.8% took the course more than once. Re-enrollment the following year was consistently higher among those who had completed the course: the rate ranged from 0.48 to 0.64 among those who finished, compared to 0.04–0.24 among those who did not, and all three differences were significant (p_FDR ≤ 0.011) (Figure 5). In contrast, re-enrollment was not associated with profile: biochemists (33.7%) and those working in the public sector (32.5%) re-enrolled more than technicians (22.6%) and those who did not (17.5%), but no difference was significant after FDR correction (minimum p_FDR = 0.175).

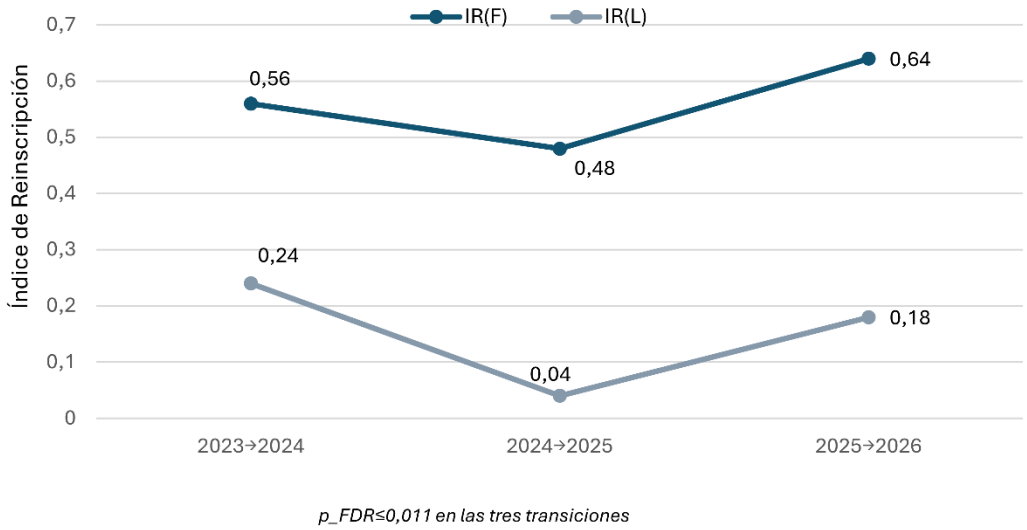

Figure 5. Re-enrollment rate (RR) for the following edition, based on the final status in the previous course offering. RR(F): the proportion of those who completed a cohort and re-enrolled the following year. RR(L): the equivalent proportion among those who did not complete the course, including individuals who never began it. All three differences were statistically significant (p_FDR ≤ 0.011; using either the chi-square test or Fisher's exact test, depending on the expected cell counts).

3.6 Change in perception among those who re-enrolled

It was possible to compare the evolution of the perception of the same individual: of the 142 survey responses, 29 were from people who responded in more than one edition. No item showed a significant change between its first and last response (Wilcoxon signed-rank test for paired samples; all p_FDR>0.6; means of 4.42–4.69 to 4.54–4.81). This result, at the intra-individual level, suggests that the homogeneity observed in section 3.3 and the stability of perception between cohorts are not simply an average among people with different characteristics.

3.7 Qualitative analysis of open questions

The thematic analysis of responses regarding the main learning outcome revealed that updating previously known concepts (19-27% of responses, depending on the cohort) and immediate practical applicability during on-call shifts (15-35%, depending on the cohort) were the two most valued aspects across all three cohorts. Within this latter category, responses did not describe content learned in the abstract, but rather its direct application to decision-making during on-call shifts—for example, "strengthening decision-making during on-call shifts" or "the course helped me organize a lot of things about how to work on-call shifts; it gave me tools that I can actually use on a daily basis"—suggesting that the perceived value of the course is more closely linked to the confidence to act in the moment than to the incorporation of new content itself.

In the general comments, an improvement was observed throughout the different editions of the course in two technical aspects: mentions of connection or sound problems (6% in 2023 to 0% in 2024 and 2025) and the request that the classes be recorded (21% in 2023 to 0% in 2024-2025), coinciding with the change of platform from Jitsi to Zoom which even made it possible to record the classes.

In the suggestions for subsequent years, the request for asynchronous modality stands out, 8-11% of the responses depending on the cohort, with explicit comments on the difficulty of coordinating on-call schedules with synchronous classes.

Within each cohort, the most frequently chosen topics were: in 2023, Puncture Fluids (84.8%), Renal Syndromes (75.8%), and Acid-Base Status (72.7%); in 2024, Interferences in Clinical Chemistry (78.0%), Toxicological Emergency Laboratory (52.0%), and Dysnatremias (50.0%); and in 2025, the two modules of Metabolic Acidosis Analysis (83.1% and 81.4%) and Hematology in the Emergency Laboratory (66.1%). In 2023, some topics were chosen by a minority of the group (minimum 15.2%); from 2024 onward, all topics were chosen by at least 25% of respondents, with median selections per topic of 50.0%, 46.0%, and 55.9% (Figure 6). None of these aspects were associated with the profile of the respondent: neither the choice of topics (45 comparisons; minimum p_FDR=0.29) nor the mentions of asynchronicity, technical problems or request for recording (16 comparisons; minimum p_FDR=0.70).

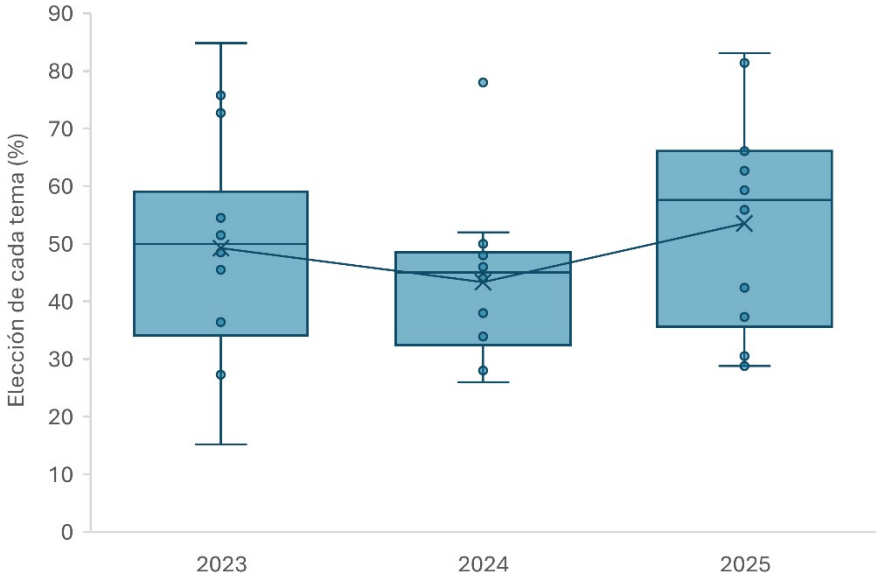

Figure 6. Distribution of the percentage of topic selections within each cohort. Each point represents a topic from the syllabus for that edition (2023: 12 topics, n=33 responses; 2024: 11 topics, n=50; 2025: 13 topics, n=59). The box indicates the first and third quartiles, the horizontal line represents the median, the 'X' marks the mean, and points beyond the whiskers represent outliers. Each participant could select as many topics as they found of interest, with no limit.

4. Discussion

This study described the experience of a free, online postgraduate course for biochemists and laboratory technicians. The main findings were high and consistent satisfaction across all profiles of those who completed the course, a significantly lower completion rate among those working outside the public sector, and a higher rate of re-enrollment among those who had completed a previous edition. The most relevant finding from an equity perspective is the dissociation between satisfaction and completion: among those who passed the course, the perceived experience was equally positive for all profiles, while the likelihood of reaching that point was not. One possible hypothesis is that in the public sector, continuing education is formally incorporated into the professional career path: current regulations require accreditation of training activities, which award points for periodic

recertification of professional practice (5, 6). This framework could generate an institutional incentive to complete started activities, which does not necessarily operate in the same way in other contexts. The qualitative analysis points in the same direction, with the recurring demand for an asynchronous modality linked to the difficulty of coordinating on-call schedules. It should be emphasized that this interpretation is a hypothesis and not a finding: the study did not reveal working hours, on-call schedules, institutional support or access to training licenses, so it does not identify the mechanism that produces the observed association nor does it allow establishing causal relationships.

Under the Continuing Education in Health approach (7, 8), it has been noted that continuing education tends to be organized as isolated training sessions, without a comprehensive plan to ensure that workers actually have the time to train. Our results provide quantitative evidence for this criticism: free access and perceived quality were not enough to equalize the likelihood of completing the program among participants from different work sectors. Lack of time and institutional incentives were also the main barriers reported by primary care teachers in Chile (9). Similar constraints appear consistently in the international literature on continuing professional development: available time, institutional support, and access to resources, over individual interest (10).

A higher completion rate was observed among biochemists compared to technicians, although this difference did not reach statistical significance (p_FDR=0.271). Paradoxically, technical staff exceeded their own expectations more frequently than biochemists. That is, among those who did complete the program, technicians more often reported a learning experience that exceeded their expectations, even though proportionally fewer technicians reached that point. We interpret this as two distinct phenomena (the experience of those who complete the program vs. the probability of completing it) that should not be confused.

Several suggestions recorded in the surveys resulted in concrete changes between editions: the platform change following the technical difficulties of 2023, the availability of recorded classes in response to recurring requests, and the incorporation of laboratory technicians as guest lecturers (2025 and 2026) in response to requests for content more geared towards that profile; however, the asynchronous modality was not included. The literature shows that synchronous and asynchronous formats achieve equivalent learning outcomes (11,12), but with different profiles: a recent randomized controlled trial found greater acceptance of the asynchronous format, but greater intrinsic motivation in the synchronous format (13), which also provides temporal structure to learning and real-time feedback (14). The demand for asynchronous learning can therefore be interpreted not as a criticism of the course's pedagogical design, but as a request in response to the difficulty of finding time imposed by the demands of urgent work. The work of Cerame del Campo et al. The non-compliance with post-guard rest periods in resident physicians in Madrid (15) illustrates this pressure.

Content reception also varied between editions: in 2023, a topic was indicated as being of interest by only 15.2%, while from 2024 onward, all topics were considered relevant by at least a quarter of the group. These differences are descriptive and also depend on how many topics each participant marked on average.

These findings should be read within the framework of the literature on continuing education in the region. The course described here is part of a set of free courses offered in public hospitals in the City of Buenos Aires and endorsed by the local health authority (4). It has characteristics not found combined in the courses reviewed: it is free, synchronous, provides credit for recertification, focuses on specific problems in the emergency laboratory, and is aimed jointly at biochemists and technicians, two profiles that share the daily practice of the emergency room. A recent study of nursing professionals in Argentina also documented a relationship between participation in continuing

education and job satisfaction (16). The observed non-completion rate is comparable to that of other free courses for health professionals; for example, Racchumí-Vela et al. reported a 68.5% dropout rate in a virtual course on statistics applied to health research (17), and Grande Ratti et al. reported an effective participation rate of only 41% in a free, synchronous virtual course for primary care professionals (18).

In the consulted literature, we found no published reports of experiences with emergency laboratory training courses. The closest thing we found was a free series of webinars from the World Health Organization for laboratory personnel, which reported high perceived usefulness and connectivity barriers similar to those observed in our first edition (19). To our knowledge, this is the first study to jointly analyze the profile, completion, and re-enrollment in a free postgraduate course for emergency laboratory personnel .

This study has limitations. It is observational, conducted at a single institution, and lacks a comparison group, thus preventing the establishment of causal relationships. The results come from a course with its own syllabus, teaching staff, and institutional context, describing a specific experience and not directly applicable to other continuing education programs. Its value lies in providing a documented case study that allows for the formulation of hypotheses verifiable in other contexts. Furthermore, the course enrollment was deliberately increased by the course director (from 75 places in 2023 to 100 from 2024 onward), so the observed number of registrations is partly a result of this decision and should not be interpreted solely as an increase in general interest in the program.

The syllabus is unique and unrepeatable for each edition of the course in different years, which makes it impossible to assess the level of interest in these topics across different cohorts. For the analysis, military/police personnel (n=11) were grouped together with private sector personnel in a "non-public" category, which prevents evaluating military/police employees as an independent group. The satisfaction survey, although analyzed under pseudonymization, was not anonymous at the time of response, which could have introduced social desirability bias toward more favorable responses. Some comparisons were made on small subgroups—for example, 18 participants from the non-public sector and 18 with no prior experience in security guard duties among those who responded to the survey—which limits the statistical power to detect real differences in these analyses. The lack of significance in these comparisons should not be interpreted as evidence of a lack of association. Finally, since the survey is sent along with the certificate, it only reflects the perceptions of those who completed the course, and this is the main limitation of the study, because the subgroup whose experience would explain the observed differences is precisely the one that is not represented. In 2024, those who had not completed the course were specifically asked about their reasons for dropping out or not starting, and only 7 responses were obtained, insufficient for analysis. Sending the survey to the entire cohort, regardless of the final result, is a planned improvement for future editions.

5. Conclusions

- The course consistently attracted a group of participants with similar characteristics throughout the four editions: mostly biochemists, from the public sector and with previous experience in emergency shifts.
- Among those who completed the course, satisfaction with this free and virtual postgraduate program was high and stable among cohorts, homogeneous among profiles, and was also maintained within the same person throughout their repeated participation in successive editions.
- Completion rates, however, were significantly lower among those working outside the public sector (private or military/police institutions), suggesting that free tuition alone does not equalize the conditions for completing continuing education.

- We hypothesize that the dissociation between satisfaction and completion is due to working conditions and the institutional framework that allow the course to be offered, rather than to the perceived quality or relevance of the program. The qualitative analysis, which highlights the difficulty of coordinating on-call schedules with the synchronous format, points in the same direction.
- Re-enrollment was considerably higher among those who had previously completed the program. This association could be linked to the experience of having completed the program or to the same conditions that allowed them to complete it. The main practical challenge this experience presents is reconciling synchronous learning with the time constraints of those working on-call shifts. Recording the classes addressed this specific need, but the demand for asynchronous learning persisted; incorporating hybrid models remains an avenue to explore.
- These results warrant studies that allow exploring causal relationships and comparing this experience with other continuing education proposals in the region.

Funding: This work was carried out without funding.
Declaration of conflict of interest: The authors declare that they have no conflict of interest.
Authors' contributions (CRediT taxonomy)**:** AGA: conceptualization, methodology, data curation, formal analysis, writing, supervision; NVR: visualization, writing; CV: project management, supervision, research, visualization, writing. All authors reviewed and approved the final version of the manuscript.
Use of artificial intelligence: Claude (Anthropic) was responsible for generating the analysis code in Python (based on the authors' specifications, who defined the analyses, reviewed the code, and verified the results), as well as for editing and proofreading. The authors assume full responsibility for the final content.

6. References

1. Arca MA. The professional practice of biochemistry in Latin America and in Argentina. *Acta Bioquím Clín Latinoam.* **2008,** 42(3), 339-359. https://www.scielo.org.ar/scielo.php?script=sci_arttext&pid=S0325-29572008000300005
2. Aguilar Galvez AR, Muñoz Zambrano ME. Competency profile in the pre-analytical phase in Medical Technology students: curricular implications. *Rev Esp Edu Med.* **2026,** 7(2). https://doi.org/10.6018/edumed.702721
3. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *Lancet.* **2007,** 370(9596), 1453-1457. https://doi.org/10.1016/S0140-6736(07)61602-X
4. Ministry of Health of the Government of the Autonomous City of Buenos Aires. Resolution No. 1787/MSGC/2016. Regulations for the Training Courses of the Ministry of Health. Official Gazette of the City of Buenos Aires. 2016. https://buenosaires.gob.ar/sites/default/files/2023-03/RESOL%201787-MSGC-16.pdf
5. Legislature of the Autonomous City of Buenos Aires. Law No. 6035. Career Path for Health Professionals of the Government of the Autonomous City of Buenos Aires. Official Gazette of the City of Buenos Aires. 2018. https://documentosboletinoficial.buenosaires.gob.ar/publico/ck_PL-LEY-LCABA-LCBA-6035-18-5508.pdf
6. Province of Buenos Aires. Law No. 10,471. Hospital Professional Career. 1986 (with amendments). https://normas.gba.gob.ar/documentos/Vmb9NTl0.html
7. Davini MC. Continuing health education. Washington DC: Pan American Health Organization. 1995. https://iris.paho.org/server/api/core/bitstreams/dea87fcd-6818-48cf-955e-2500aa09a250/content
8. Merhy EE, Feuerwerker LCM, Ceccim RB. Continuing health education: a strategy to intervene in the micropolitics of health work. *Salud Colect.* **2006,** 2(2), 147-160. https://doi.org/10.18294/sc.2006.62
9. Reyes Rojas M, Rodríguez Navarro D. Perception of clinical tutors belonging to family health centers in Chile on the barriers to clinical teaching in primary care. *Rev Esp Edu Med.* **2025,** 6(2). https://doi.org/10.6018/edumed.645591

10. Hakvoort L, Dikken J, Cramer-Kruit J, et al. Factors that influence continuing professional development over a nursing career: a scoping review. *Nurse Educ Pract.* **2022,** 65, 103481. https://doi.org/10.1016/j.nepr.2022.103481
11. He L, Yang N, Xu L, Ping F, Li W, Sun Q, et al. Synchronous distance education vs traditional education for health science students: a systematic review and meta-analysis. *Med Educ.* **2021,** 55(3), 293-308. https://doi.org/10.1111/medu.14364
12. Thomas B, Radhakrishnan SK, Ramakrishnan RT. The effectiveness of synchronous online clinics and conventional clinics among medical students: assessing the influence of e-learning. *J Educ Health Promot.* **2024,** 13, 409. https://doi.org/10.4103/jehp.jehp_194_24
13. Zsifkovits M, Amplatz L, Triebner N, Utz J, Kornhuber J, Spitzer P. Randomized controlled trial of asynchronous vs. Synchronous online teaching formats: equal knowledge after training, greater acceptance and lower intrinsic motivation through asynchronous online learning. *BMC Med Educ.* **2025,** 25(1), 850. https://doi.org/10.1186/s12909-025-07481-4
14. MacNeill H, Masters K, Nemethy K, Correia R. Online learning in health professions education. Part 1: teaching and learning in online environments: AMEE Guide No. 161. *Med Teach.* **2024,** 46(1), 4-17. https://doi.org/10.1080/0142159X.2023.2197135
15. Cerame del Campo A, Maiques Gámez M, Coucheiro P, Cayuela Rodríguez L. Descriptive study on time off from on-call shifts for Resident Physicians in Madrid: effect of the 2020 strike on compliance with mandatory rest periods. *Rev Esp Edu Med.* **2021,** 2(2). https://doi.org/10.6018/edumed.490691
16. Barbiani O, Silva L, Manzur K. Continuing education and job satisfaction among Argentine nursing professionals. *Rev Esp Edu Med.* **2025,** 6(4). https://doi.org/10.6018/edumed.673691
17. Racchumí-Vela A, Sanchez L, Quispe-Juli CU. Dropout rate in an online course on statistics applied to health research. *Inv Ed Med.* **2024,** 13(51), 33-41. https://doi.org/10.22201/fm.20075057e.2024.51.23565
18. Grande Ratti MF, Di Croce G, Pratola CA, Godoy AC, Kopitowski KS, Juana C. Virtual course on qualitative research aimed at primary care professionals. *Rev Hosp Ital B Aires.* **2026,** 46(2), e0001281. https://doi.org/10.51987/Rev.Hosp.Ital.B.Aires.v46i2.1281
19. Barnadas C, Stevens L, Milhano N, Barbosa de Lima AC, Struminger B, Burke L, Cognat S. WHO public health laboratories webinar series – an online platform to disseminate testing recommendations and best practices during health emergencies. *Front Public Health.* **2025,** 12, 1462756. https://doi.org/10.3389/fpubh.2024.1462756

© 2026 University of Murcia. Submitted for open access publication under the terms and conditions of the Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 Spain License (CC BY-NC-ND) (http://creativecommons.org/licenses/by/4.0/)