Reflections on a Respiratory Therapy Postgraduate Certificate Program in Chile

Eduardo Kattan[1], Roque Basoalto[1,2,4], Jaime Retamal[1,3,5], Vanessa Oviedo[1], Alejandro Bruhn[1,5], and Guillermo Bugedo[1]

[1]Departamento de Medicina Intensiva del Adulto, Facultad de Medicina, [2]Cardiorespiratory Research Laboratory, Departamento Ciencias de la Salud, and [3]Institute for Biological and Medical Engineering, Schools of Engineering, Medicine and Biological Sciences, Pontificia Universidad Católica de Chile, Santiago, Chile; [4]Programa de Medicina Física y Rehabilitación, Red Salud UC-CHRISTUS, Santiago, Chile; and [5]Center of Acute Respiratory Critical Illness (ARCI), Santiago, Chile

ORCID IDs: 0000-0002-1997-6893 (E.K.); 0000-0002-8908-7397 (R.B.); 0000-0002-6817-3659 (J.R.); 0000-0001-8034-1937 (A.B.); 0000-0001-7527-6202 (G.B.)

ABSTRACT

Chile is a South American country that spans 4,300 km from north to south. Population density and access to critical care are highly concentrated in Santiago's metropolitan region. After the educational challenges posed by the 2009 H1N1 influenza pandemic, our critical care department at the Pontificia Universidad Católica de Chile in Santiago created the Respiratory Therapy Postgraduate Certificate as an educational intervention to address the shortage of healthcare professionals with knowledge and skills in performing respiratory support in critically ill patients. Throughout this Perspective, we aim to delineate the program design, major educational results, implementation of educational innovations that allowed us to adapt to the geographical challenges of the country and those imposed by the coronavirus disease (COVID-19) pandemic, and future challenges identified for the next decade.

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Correspondence and requests for reprints should be addressed to Guillermo Bugedo, M.D., Departamento de Medicina Intensiva, Facultad de Medicina, Pontificia Universidad Católica de Chile, Avenida Diagonal Paraguay 362, 8330077 Santiago, Chile. E-mail: gbugedo@gmail.com.

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Chile, situated in South America, is home to approximately 20 million people (1). Although the Chilean healthcare system displays commendable and cost-effective healthcare indicators (2, 3), the nation faces distinctive challenges because of its geographical and socioeconomic diversity (4). Chile stretches 4,300 km from north to south, harbors income inequality across various regions, and encounters limited access to healthcare facilities and professionals in sparsely populated areas (5, 6). These factors contribute to the heightened complexity of delivering quality care, particularly in critical-care scenarios (7).

Throughout the years, the care of patients requiring ventilatory support has improved consistently, integrating strategies such as noninvasive support and invasive support, lung protective mechanical ventilation (8), positive end-expiratory pressure titration and prone positioning (9), as well as sedation, weaning and rehabilitation protocols, and preventive measures against infectious complications. Nonetheless, trained professionals in the physiological and clinical aspects of respiratory and critical care who can deliver high-quality interprofessional and coordinated care are required to correctly apply these strategies (10).

During the 2009 H1N1 influenza pandemic, the Chilean healthcare system was significantly strained, leading to the saturation of intensive care units (ICUs) and increased mortality rates (11). This scenario accentuated the previously mentioned disparities and the shortage of trained healthcare professionals in the field of respiratory therapy for critically ill patients across the nation (12).

At an academic center with an extensive record in training healthcare professionals at the graduate level and significant research experience in the field of mechanical ventilation and acute respiratory distress syndrome (ARDS) (13–18), we developed and launched a postgraduate certificate focused on respiratory therapy for critically ill patients in 2010. This program has been consistently offered to the present day and encompasses the development of cognitive and practical skills relevant to mechanical ventilation conduction in the ICU. The purpose of this report is to delineate the challenges encountered during this decade and describe the program's evolution and future directions in light of the lessons learned through this period, during which technology and translational and clinical research have advanced exponentially.

CERTIFICATE DESIGN AND DESCRIPTION

The Respiratory Therapy Postgraduate Certificate (RTPC) was created by the critical care department at the Pontificia Universidad Católica de Chile in Santiago, the capital of Chile. The RTPD was launched in 2010, and, since that time, it has been given yearly for a period of 20 weeks, usually from April to September. The program is designed to integrate core and advanced topics on the physiological and pathophysiological determinants of respiratory failure, mechanical ventilation in different contexts, as well as sedation, weaning, and extracorporeal life support, in line with CoBaTrICE (Competency-Based Training in Intensive Care Medicine in Europe)

framework (19). This program amounts to 20 credits of continuous professional education according to the national educational structure.

The RTPC has been continuously evolving and adapting over the years (Figure 1). The management of patients with respiratory failure and invasive or noninvasive ventilatory support requires multidisciplinary management, particularly involving physicians, nurses, and physiotherapists. Among the prerequisites to participate, prospective students had to demonstrate work experience in the critical-care environment and a personal statement that justified their interest in the program. For this reason, from the beginning, the RTPC incorporated faculty members from various professions, pointing not only to the technical aspects of ventilation, but also general care, the prevention of infections, and complex decision-making in patients with uncertain prognoses. Three methodological iterations were performed according to perceived challenges and opportunities.

Original Version

For the first version of the RPTC, a total of seven in-person meetings were arranged, held from Friday to Saturday. Educational strategies included live classes, case analysis and small group discussion, workshops involving practical and hands-on activities, and bibliographic reviews. All lectures and reference materials were recorded and distributed on a USB drive, which was regularly updated at the conclusion of each session.

Hybrid Version

One of the first limitations identified after the first version was the relative difficulty for students from regions other than Santiago to participate. Thus, in subsequent years, online resources, including a web-based platform, prerecorded lectures, and bibliographic materials, along with written examinations, were made accessible right from the outset of the certificate program, and the presential sessions were limited to four but prolonged from Thursday to Saturday. In subsequent years, and with the implementation of a professional web-based learning management system (based on the academic web service of our university), all bibliographic material and most lectures were available online and two 20-hour presential sessions (which were live-streamed) from Thursday to Saturday were maintained for master classes, case discussions, and practical hands-on activities.

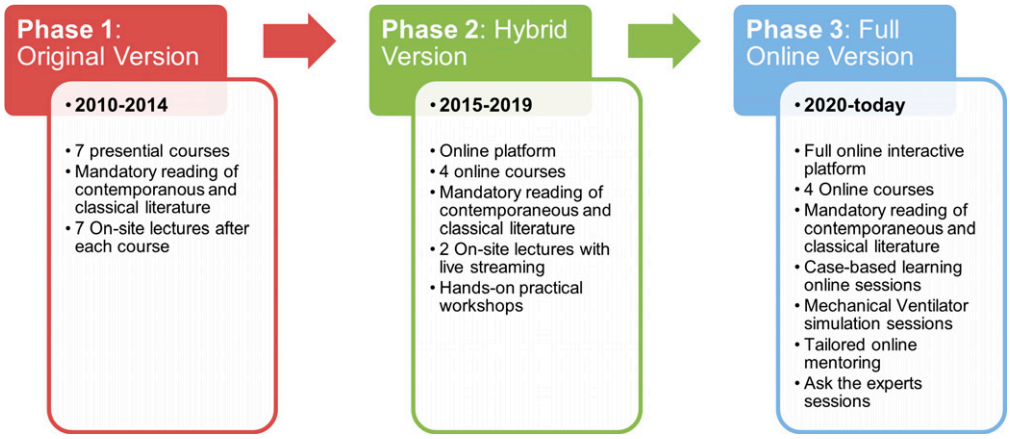

Figure 1. Evolution of the curriculum of the Respiratory Therapy Postgraduate Certificate.

Full Online Version

After the emergence of the severe acute respiratory syndrome coronavirus 2 (SARS CoV-2) pandemic, the following lockdown resulted in the disappearance of in-person meetings, prompting a shift toward the use of online videoconference platforms (File E2 in the online supplement). Thus, a 100% online program was generated, incorporating new educational tools such as virtual case-based discussion, virtual simulation scenarios, question-and-answer sessions, and "ask the expert" sessions. To maintain interaction between faculty and students and between students, we developed a tutoring program. Eight online tutors (trained critical care physicians) accompanied groups of 10–15 students throughout the program development and had regular online meetings discussing clinical cases, following a checklist of core concepts that facilitated the intended learning objectives.

The faculty currently comprises intensive care physicians, physiotherapists, registered nurses, and other allied health care professionals, most from Chile, but also internationally renowned professors, clinicians, or scientists who are invited to participate. Among the coordinating team of the RTPC, we have four research leads on mechanical ventilation who have Ph.D. degrees and two educational leads who have master's degrees in medical education. The curriculum is summarized in Table 1, and the full version is provided in File E1. This certificate is certified by the university graduate medical office.

EDUCATIONAL OUTPUTS DURING THIS DECADE

From the first version in 2010 to the most recent 2022 version of the RTPC, 1,177 students have been admitted to the program. Throughout the years, the number of students per cohort has steadily increased, from 35 students in 2010 to 126 in 2022, as shown in Figure 2. As the certificate evolved, there were significantly more students from outside the Santiago metropolitan area. The aggregated geographic distribution of RTPC students, along with the number of ICU beds and population of each region of Chile, is presented in Figure 3.

At the beginning of the certificate, a 35-question diagnostic test was performed, encompassing all the topics slated for instruction in the course via multiple-choice questions, and feedback is given to students. Then, at the conclusion of each course, a summative examination was conducted with posterior feedback. Finally, a 70-question final test was performed at the end of the certificate, which included 50% of questions already asked in the previous assessments. The scoring system ranges from 1.0 (minimum) to 7.0 (maximum), with a minimum passing score of 4.0, which corresponds to achieving a 70% correct answer rate. To successfully complete the program and earn a certificate, students are required to maintain an overall average higher than 4.0 across all summative assessments conducted during the RPTC program.

Of the 1,177 students enrolled, 41% ($n = 487$) were female. Median age was 31 (range, 28–35) years. Regarding the students' background professions, 47% ($n = 552$) of them were physicians, 44.1% ($n = 519$) physiotherapists, 7.4% nurses ($n = 87$), 0.4% ($n = 5$) veterinarians, and 0.1% ($n = 1$) clinical pharmacists. Regarding previous experience of graduate training, 41% of students ($n = 487$) had previous formal clinical training, 4% (46) had earned a master's degree, 0.2% ($n = 3$) had completed a

Table 1. Current curriculum of the Respiratory Therapy Postgraduate Certificate

Course	Respiratory Pathophysiology and Acute Respiratory Failure	Introduction to Mechanical Ventilation	ARDS	Challenges in Ventilatory Therapy
Duration	5 wk	5 wk	5 wk	5 wk
Credits	5 CME credits	5 CME credits	5 CME credits	5 CME credits
Contents	-Mechanical properties of the respiratory system -Cardiopulmonary interaction -Acute respiratory failure -Oxygen therapy, HFNC, and NIV -Indications of tracheal intubation	-Volumetric modalities -Pressurized modes -Total and partial ventilatory support -Mechanics -Cardiopulmonary interaction -Asynchrony -MV monitoring -Imaging	-ARDS -VILI and protective ventilation -Alveolar recruitability and PEEP setting -Prone and NMB -Refractory hypoxemia and ECMO -MV protocol -Ventilatory support in asthma/COPD	-Sedation and delirium during MV -Weaning process -Airway management and tracheostomy -Chronic critically ill patient -Rehabilitation -Ventilator-associated pneumonia

Definition of abbreviations: ARDS = acute respiratory distress syndrome; CME = continuing medical education; COPD = chronic obstructive pulmonary disease; ECMO = extracorporeal membrane oxygenation; HFNC = high-flow nasal cannula; MV = mechanical ventilation; NIV = noninvasive ventilation; NMB = neuromuscular blocker; PEEP = positive end-expiratory pressure; VILI = ventilator-induced lung injury.

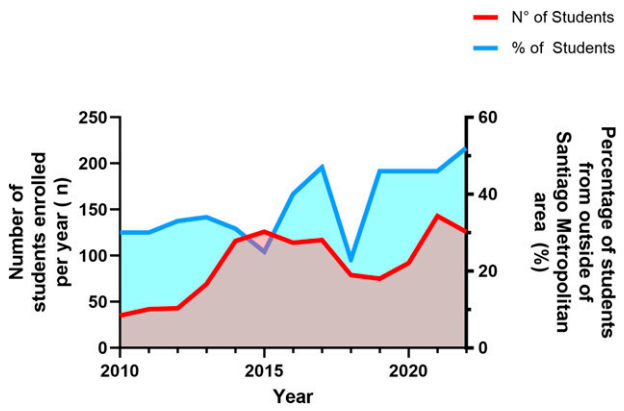

Figure 2. Evolution of the number of students enrolled in the certificate and their regional origin over time.

Ph.D. program, and 54.4% ($n = 641$) had no previous graduate training experience.

Figure 4 shows the comparison of aggregated scores in the diagnostic tests and final grades in the whole cohort of students. Of note, although only 50% had a score higher than the minimum passing score on the diagnostic test, only 3% failed the certificate. When the program had been completed, students provided structured feedback through the university platform. This feedback included domains such as quality, organization, teaching strategies, feedback, and assessment, and helped improve the next year's program.

Current Challenges and Future Directions

During these 10 years, our RTPC has evolved in light of the latest evidence published. Thus, relevant topics such as the use of high-flow nasal cannulae or awake prone positioning during noninvasive management of respiratory failure were incorporated in recent years, following the study of Frat and colleagues and

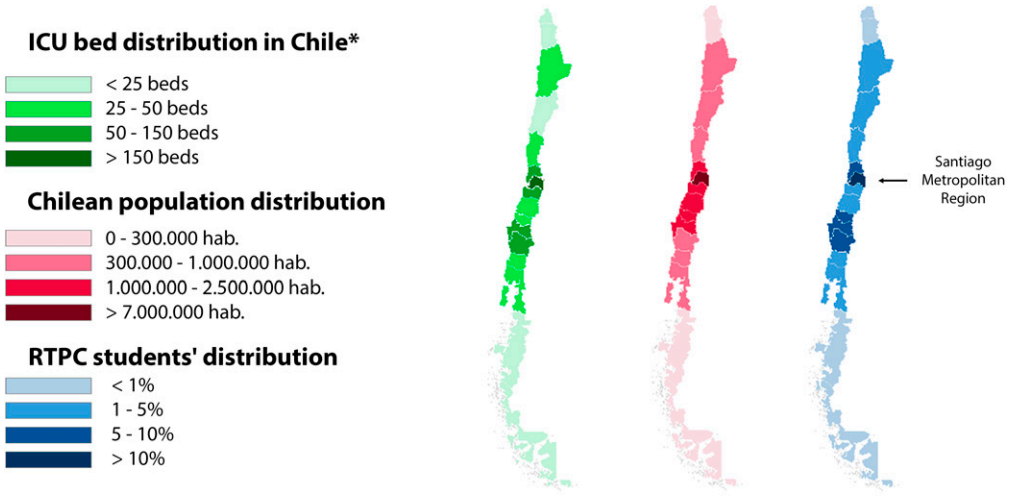

Figure 3. ICU bed distribution (green), population distribution (red), and student distribution (blue) throughout Chile. ICU = intensive care unit; RTPC = Respiratory Therapy Postgraduate Certificate.

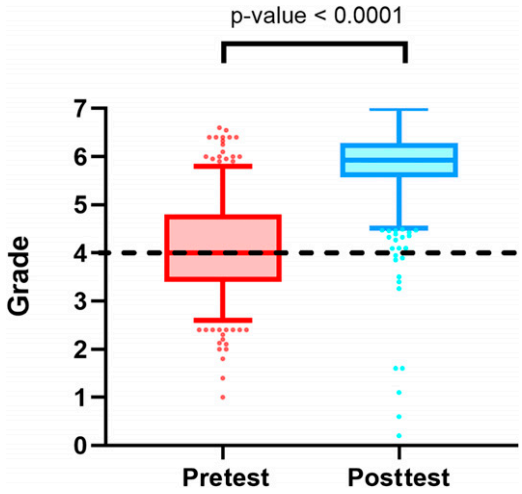

Figure 4. Evolution of trainees' grades from pretest to posttest during the Respiratory Therapy Postgraduate Certificate process.

the SARS-CoV-2 virus (coronavirus disease [COVID-19]) pandemic experience (20, 21). Also, studies on neuromuscular blockade (22, 23) and prone positioning (9) in patients with moderate to severe ARDS under protective mechanical ventilation, published in 2010 and 2013, generated a tremendous impact on our guidelines for the management of refractory hypoxemia, which were rapidly transferred into the RTPC in theoretical and practical domains. In contrast, high-frequency oscillatory ventilation (24), which was a trending therapy for ARDS during the H1N1 pandemic, was removed from the core curriculum after the landmark studies, to one of which we also contributed (25). Of note, our group has had an active and significant contribution to the generation of meaningful research on ARDS and mechanical ventilation (14, 25–27). This contribution has enriched the depth of discussion during the coverage of these topics throughout the certificate. Also, of added value for students, sharing with researchers gave them the opportunity to approach to the challenges and opportunities of performing research in a low- or middle-income country.

Among our students' distribution, almost 45% were physicians and 45% physiotherapists, with smaller numbers of other ICU-related health professionals. This heterogeneity of backgrounds became a challenge to our program development throughout the years. Interestingly, we tackled this issue by integrating an interprofessional faculty and articulating lectures to provide a holistic approach. Also, the contents focused on the key aspects of ventilatory management process that are common ground to all ICU professionals. For example, in an immunosuppressed patient, we focused on the decision-making process: how to program invasive mechanical ventilation, or the adequacy of therapy versus tracheostomy indication, rather than the specific antimicrobial therapy in this scenario. Since the start of our program, an interprofessional and collaborative approach has been part of the guiding principles. On the contrary, as made evident in Figure 2, there has been an important shift in regional distribution in recent years, with a majority of professionals now residing outside the greater Santiago metropolitan area. Throughout this decade, the introduction of novel

educational resources and technological development has aided in decreasing geographic barriers to increase the outreach of this program to the more remote areas of Chile, where, as shown in Figure 3, the availability of ICU beds and trained healthcare providers is considerably lower. However, with this curriculum shift, novel issues emerged. For example, even though hands-on teaching had been highly esteemed by students in previous iterations, it could not be performed in the virtual version. We tackled this issue using virtual simulators and case-based learning (28, 29).

Considering the initial concentration of students in the main metropolitan area, we rapidly shifted from a full in-person version to hybrid teaching and learning methodologies, but the SARS-CoV-2 pandemic finally pushed for a transformation into a fully online program (28). Different educational strategies that integrated technological resources such as webinars, case-based discussions, and simulation sessions allowed us to address higher levels of the Miller pyramid (30) and create a sense of community among students and faculty. The role of tutors has also been a perceived strength of the program by faculty and trainees because they can guide and resolve doubts in real time for students, develop closer relationships, and enhance the sense of a community of learning that could be potentially lost in a fully online program (29, 31). This sense of community was further enhanced by maintaining open social media channels, a blog (https://medicina.uc.cl/terapia-ventilatoria-uc/), an alumni WhatsApp group, and further courses on advanced mechanical ventilation.

Despite the educational success of the past decade, we face novel challenges for the future, so continuous improvement efforts of the program should focus on constant innovation and increasing reach. First, other online graduate programs on respiratory support have emerged in the country after the COVID-19 pandemic. Comparative advantages of our program (including national and international faculty, integration of simulation and case-based learning, and providing university-based certification) should be exploited to maintain students' interest. The accrued experience could serve as a platform to develop spin-off training programs related to respiratory failure, such as advanced airway management and extracorporeal membrane oxygenation support short courses (17). On the contrary, the technological developments that allowed us to transition to a fully online course could serve as a platform to provide regional training throughout Latin America. Nonetheless, the program should be adapted adequately to account for regional and local realities, cultural organization, resources, and clinical practice.

In conclusion, the implementation of a postgraduate program on mechanical ventilation has effectively contributed to increase the healthcare workforce trained on the provision of care for critically ill patients with respiratory failure throughout Chile. Multiple educational innovations have allowed the program to be adapted to the geographical challenges of the country and those imposed by the COVID-19 pandemic. Future improvements should aim on the assessment of the programs' impact on clinical practice, regionalization of the educational offer throughout Latin America, and provision of advanced spin-off courses related to mechanical ventilation.

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