



# The evolution of mechanical ventilation, a breath of innovation with a legacy in limbo

La evolución de la ventilación mecánica, un soplo de innovación con un legado en el limbo

*A evolução da ventilação mecânica, um sopro de inovação com um legado no limbo*

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Mechanical ventilation (MV) has played a crucial role in modern medicine, especially in the Critical Care and Anesthesia arena. Its history is a story of innovation, collaboration, and eventually, consolidation in the medical equipment industry. A significant chapter in this history involves the emergence of Puritan Bennett, a pioneer in mechanical ventilation equipment, which in turn arose from the merger of two American companies, Puritan and Bennett.

This editorial will explore the company's journey, its products, mergers, and its eventual dissolution as a standalone entity under the huge Medtronic umbrella.

## THE BEGINNINGS OF MECHANICAL VENTILATION

The roots of MV can be traced back to the early 20<sup>th</sup> century when the need for artificial breathing support became evident. The development of intensive care has been considered to be closely intertwined in general with that of mechanical ventilators and Dr. Bjorn Ibsen, an outstanding anesthesiologist from Copenhagen in particular, as the father of intensive care for having organized the care of polio patients with ventilatory failure in special units, introducing tracheostomy and ventilation with mechanical or manual positive pressure.<sup>1</sup>

Initially, devices were rudimentary, primarily focusing on providing basic oxygen support. However, as our understanding of complex respiratory physiology advanced, so did the technology. By the 1950's and 1960's, mechanical ventilators evolved into advanced machines capable of providing various modes of ventilation tailored to individual patient needs.

## EMERGENCE OF PURITAN BENNETT

Puritan Bennett (PB) was founded in 1913 with an initial foray into the medical gasses industry and in 1940, its

founder Ray Bennett invented a MV as an alternative to the iron lung machine of those polio times,<sup>2</sup> and over time but quickly established itself as a leader in the field of MV.

As a medical student I met the Bennett PR-2 ventilator in different clinical rotations, but when I entered undergraduate internship my first contact with mechanical ventilation was with the old green transparent plastic Bird boxes of different generations, but the kings of the show were a pair of robust metallic blue Puritan-Bennet MA-1's volumetric ventilators, initially without a PEEP valve so adaptations had to be made according to the recommendations of the Denver group; it was a volume-cycled constant flow generator that had three different adjustable modes: assisted, controlled, and assist-controlled, and was the most used ventilator worldwide<sup>3</sup> (Figure 1).

This particular ventilator personally represents a nostalgic memory of my beginnings in the MV field, memories reinforced during my specialist training in Critical Care with the MA-2 PB ventilator and eventually in the United States with the PB-7200 and others more in recent years, as the flagship product of Puritan Bennett's line of critical care ventilators, the 840 ventilator system with an extensive and modern software.

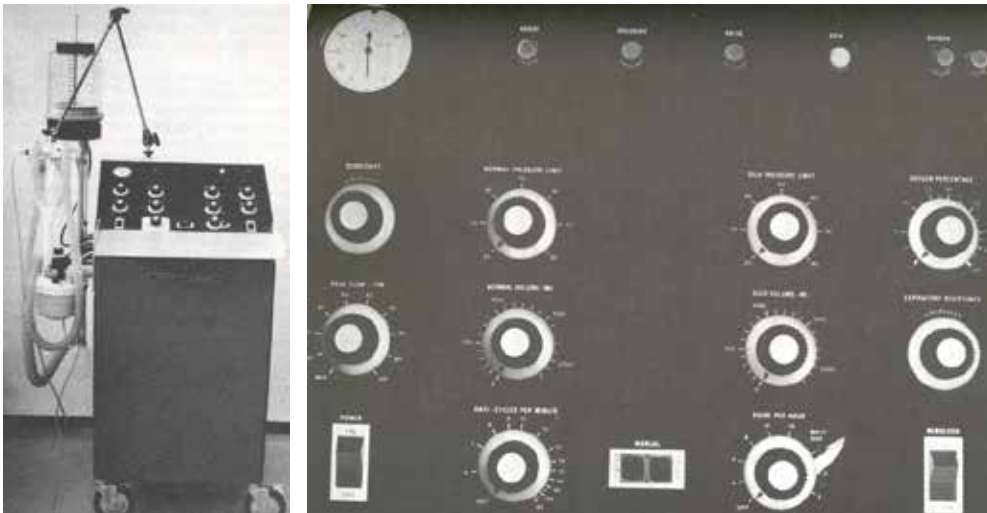
The company's commitment to innovation led to the development of several groundbreaking ventilators. For instance, their model PB 7200, released in 1971, was significant for its ability to provide volume-assured ventilation, a feature that set it apart from competitors at the time. This advancement allowed healthcare providers to deliver consistent tidal volumes to patients, which was critical for both acute and chronic respiratory failure treatment.

In the late 1980's, Puritan Bennett made a name for itself with the introduction of the aforementioned PB 840 ventilator, a groundbreaking product that combined flexibility and advanced technology for a wide range of patients, including neonates and adults. The PB 840 was equipped with features such as a pressure and volume control mode, which further enhanced its utility in many clinical settings.

Recently the Puritan Bennett 980 series ventilator was very well recognized for several merits that have made it a valuable tool in Critical Care: versatility in

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**How to cite:** Elizalde-González JJ. The evolution of mechanical ventilation, a breath of innovation with a legacy in limbo. Med Crit. 2024;38(4):236-238. <https://dx.doi.org/10.35366/118212>



**Figure 1:**

Puritan Bennett MA-1 volumetric ventilator used at the ABC Hospital since its opening.

ventilation modes, non-invasive ventilation options, advanced monitoring, intuitive interface, adaptation technology, portability and compact design, integration capabilities (for example with EPIMED software),<sup>4</sup> and the complete support for neonatal and pediatric patients.

### STRATEGIC MERGERS AND ACQUISITIONS

In an effort to expand its market reach and enhance technological capabilities, Puritan Bennett merged over time with other companies (Nellcor, Mallinckrodt, PB Aero Systems, BE Aerospace, Tyco International, Covidien respectively). One of the key mergers was with the medical equipment manufacturer, the Covidien Healthcare company. This merger allowed for shared resources and expertise, culminating in the development of enhanced ventilators and respiratory care systems. Together, these companies produced devices that addressed the complexities of MV more effectively than ever before.

However, the most significant change came when Covidien itself was acquired by Medtronic ten years ago in 2014. Medtronic, already a giant in the medical device sector, recognized the potential for growth in the respiratory market. It aimed to integrate Puritan Bennett's innovative technology into its broader portfolio of medical solutions. Under Medtronic's guidance, the division produced a new line of ventilators that combined Puritan Bennett's legacy of innovation with Medtronic's robust distribution and manufacturing capabilities.

### A SHIFT IN STRATEGY: THE CLOSURE OF THE MECHANICAL VENTILATION DIVISION

Despite its innovative history and the crucial role Puritan Bennett played in advancing MV, Medtronic went public on February 20 an unfortunate and surprising decision

to discontinue its production of mechanical ventilators and focus on other segments of its business. This decision was driven by several strategic commercial, financial, and economic factors, including market competition, evolving healthcare needs, and the rising costs associated with production.

The resolution was also related to business strategy and reorientation of resources, especially after the increase in demand for ventilators during the COVID-19 pandemic.

During its reports of the third quarter fiscal 2024 financial results (which ended January 26, 2024) the key highlights were: 1. Revenue of \$8.1 billion increased 4.7% as reported and 4.6% organic. 2. GAAP diluted earnings per share (EPS) of \$0.99; non-GAAP diluted EPS of \$1.30. 3. Raises FY24 organic revenue growth and EPS guidance. 4. Company provides portfolio management updates on patient monitoring and respiratory interventions businesses. 5. Received U.S. FDA approval for PulseSelect™ pulsed field ablation (PFA) system and Percept™ RC neurostimulator with BrainSense™ technology; CE Mark for MiniMed™ 780G System with Simpler Sync™ CGM and Micra™ AV2 and Micra™ VR2 leadless pacemakers.

In the patient monitoring and respiratory interventions (PMRI) update section, Medtronic published its decision to abandon its ventilator product line and retain and combine PMRI's remaining businesses into a business unit called acute care and monitoring (ACM). Exiting the increasingly unprofitable ventilator product line and combining the remaining businesses will allow for a greater investment in ACM with a focus on profitable growth. Given this increased investment coupled with an improved competitive landscape, the company has a strong conviction in driving lasting category leadership in this newly combined business. Medtronic will continue to fulfill existing ventilator contracts to meet the needs

of its customers and patients, and expects that existing MV manufacturers, which represent most of the market today, will be able to meet customer demand for new ventilators in the future.<sup>5</sup>

The announcement shocked many within the medical community including me. Puritan Bennett had been synonymous with quality and reliability in MV for decades; the discontinuation of this division marked the end of an era. This move is indicative of a broader trend in the medical industry, where companies prioritize core competencies and seek to streamline operations in an ever-evolving marketplace focused on efficiency and cost-effectiveness, an understandable policy but one that affects many areas in the medical profession, like the yearly traditional «*Alveolo Bowl™*» of COMMEC, one of the central events of our national congresses.

### CONCLUSION

The story of Puritan Bennett encapsulates the progression and challenges of MV as a field. From its early days, through innovation and strategic mergers, to its eventual dissolution as a standalone entity, Puritan Bennett has left an indelible mark on the medical profession. While its products once symbolized hope for patients facing respiratory crises, their disappearance from the landscape reflects the harsh realities of market dynamics in the medical device industry.

As we look to the future of MV, the legacy of Puritan Bennett serves like an inspiration and as a reminder of the ongoing need for innovation, investment, and dedication in medical technology—qualities that are vital to advancing healthcare and improving patient outcomes. Although Puritan Bennett may no longer exist in its previous form, the impact of its contributions will continue to shape the field of MV in Critical Care for years to come.

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