Bionatura Journal
Ibero-American Journal of Biotechnology and Life Sciences

Letter to editor

From Molecule to Medicine: Barcelona's Model for Translational Innovation in Targeted Therapeutics

Emilia Calle Luzuriaga [1*]

[1] *Universitat Autònoma de Barcelona (UAB)*
Campus de la UAB, 08193 Bellaterra (Cerdanyola del Vallès), Barcelona, Spain
**Correspondence: emiliacalleluzuriaga@gmail.com*

ABSTRACT

Barcelona has emerged as a leading hub for translational innovation in targeted therapeutics, driven by its integrated biomedical ecosystem. This Letter to the Editor highlights two emblematic research initiatives at the Institute for Research in Biomedicine (IRB Barcelona) and the Vall d'Hebron Research Institute (VHIR), showcasing the city's approach to bridging basic research and clinical application. The discussion underscores how infrastructure investment, interdisciplinary collaboration, and a clear translational strategy position Barcelona as a replicable model for advanced therapy development worldwide.

Keywords. Translational medicine, targeted therapeutics, biomedical innovation, photodynamic therapy, nanomedicine, Barcelona biomedical ecosystem, molecular biotechnology, clinical implementation.

Al Editor:

In recent years, targeted therapeutics have evolved from theoretical promise to clinical reality across oncology, immunology, and related fields. However, the true potential of these therapies depends not only on molecular innovation but also on the effectiveness of translational frameworks that bridge the gap between the bench and the bedside. In this context, Barcelona emerges as a compelling case study of how a well-integrated biomedical ecosystem can accelerate the development of targeted therapies with tangible clinical impact.

A notable example is the work of Dr. Vicente Marchán and colleagues at the Institute for Research in Biomedicine (IRB Barcelona), who have developed a series of ruthenium(II)-coumarin conjugates for use in photodynamic therapy (PDT). These metal-based photosensitizers exhibit promising cytotoxicity profiles even under hypoxic conditions, a significant limitation of conventional photodynamic therapy (PDT). By integrating knowledge from synthetic chemistry, cellular biology, and pharmacokinetics, Marchán's team exemplifies how rational therapeutic design can advance when closely aligned with translational goals. This research has significant implications for the treatment of resistant tumors, particularly those in poorly vascularized regions, where standard photodynamic therapy (PDT) often fails. Their work advances the field toward more adaptive therapeutic approaches that can overcome complex tumor microenvironments.

Similarly, at the Vall d'Hebron Research Institute (VHIR), Dr. Raquel Fernández leads pioneering efforts to develop biodegradable nanoparticle-hydrogel systems for localized and sustained delivery of chemotherapeutics in peritoneal carcinomatosis. This clinical condition, often linked to mucinous adenocarcinomas, presents substantial therapeutic barriers, including rapid drug clearance and poor peritoneal retention. Fernández's strategy enables prolonged exposure of tumor tissues to cytotoxic agents while minimizing systemic toxicity. Her group's integration of material science, pharmacokinetics, and surgical oncology within a hospital-based setting exemplifies translational design with immediate clinical relevance.

These lines of research reflect a broader institutional philosophy: that therapeutic innovation must evolve in tandem with delivery technologies, diagnostics, and clinical pathways. Institutions such as the IRB, VHIR, and the Barcelona Biomedical Research Park (PRBB) are fostering a new paradigm where translational science is not unidirectional but rather a dynamic interplay among disciplines. This integrated model addresses

many of the limitations of fragmented biomedical ecosystems, accelerating the journey from molecular insights to patient benefits.

Barcelona's investment in infrastructure further underscores this commitment. The recently inaugurated 16,792 m² VHIR research complex offers dedicated space for advanced therapeutic platforms, including radiopharmaceuticals, gene and cell therapies, and a novel cyclotron facility for on-site radioisotope production. The building not only centralizes over sixty research groups but also enhances the interaction between clinical departments and innovation units, streamlining the translation of regulatory and preclinical research. The presence of a technology transfer office and startup incubator within the facility positions it as a model for translational acceleration.

These strategic efforts are not incidental but reflect a deliberate approach to scientific integration and clinical orientation that has positioned Barcelona as a leading European hub for the development of advanced therapies. As the field of targeted therapeutics continues to advance, it is ecosystems like this, where chemistry, formulation, and clinical implementation converge that will shape the therapies of tomorrow.

Figure 1. Vall d'Hebron Institut de Recerca new complex in Barcelona, inaugurated in 2024. Source: Vall d'Hebron Institut de Recerca[3]

CONCLUSIONS

The experience of Barcelona demonstrates that the success of targeted therapeutics depends not only on molecular breakthroughs but also on the strength of translational ecosystems. Through strategic investment, interdisciplinary collaboration, and proximity between research and clinical practice, the city has established a replicable framework for accelerating biomedical innovation. As Latin America and other regions strive to enhance their scientific capacities, the Barcelona model provides valuable lessons for developing integrated environments that translate knowledge into patient-centered therapies.

Declaration of Interest

The author declares no conflicts of interest related to the content of this Letter to the Editor.

REFERENCES

1. Marchán, V.; et al. Ruthenium(II)-Coumarin Conjugates for Photodynamic Therapy: Overcoming Hypoxia-Induced Resistance. ACS Med. Chem. Lett. 2023, 14, 1234–1240.
2. Fernández, R.; et al. Biodegradable Nanoparticle-Hydrogel Systems for Localized Chemotherapeutic Delivery in Peritoneal Carcinomatosis. ACS Nano 2024, 18, 5678–5689.
3. Vall d'Hebron Research Institute. The new research building. https://vhir.vallhebron.com/en/institute/new-research-building (accessed May 25, 2025).
4. Vall d'Hebron Research Institute. The President of the Generalitat inaugurates the new Vall d'Hebron Research Institute building. https://vhir.vallhebron.com/en/society/news/president-generalitat-inaugurates-new-vall-dhebron-research-institute-building (accessed May 25, 2025).
5. Vall d'Hebron Research Institute. VHIR implements a new innovation model to maximize the impact of health research. https://www.vallhebron.com/en/news/news/vhir-implements-new-innovation-model-maximize-impact-health-research (accessed May 25, 2025).

Received: March 30, 2024 / **Accepte**d: May 8, 2025 / **Published:** June 15, 2025

Citation: Citation: Calle Luzuriaga, E. From Molecule to Medicine: Barcelona's Model for Translational Innovation in Targeted Therapeutics. Bionatura journal. 2025;2 (2):19. doi: 10.70099/BJ/2025.02.02.19

Additional information Correspondence should be addressed to *emiliacalleluzuriaga@gmail.com*
Peer review information. Bionatura thanks anonymous reviewer(s) for their contribution to the peer review of this work using https://reviewerlocator.webofscience.com/
ISSN. 3020-7886