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Bioecological Theory of Human Development and Medical Education: Scoping Review.

Teoría Bioecológica del Desarrollo Humano y educación medicas: Revisión de alcance.

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Summary.
Introduction: Postgraduate medical education is a critical stage for consolidating clinical professionalism, specialized competencies, and professional identity. The clinical environment—including mentors, regulations, and institutional culture—influences resident development. Bronfenbrenner's Bioecological Theory of Human Development (BETHD), and its operationalization in the Process-Person-Context-Time (PPCT) model, offers a framework for understanding how multiple contextual levels interact and influence the training experience. **Objective** : To map studies that apply BETHD in postgraduate medical education, identify levels of analysis, describe methodologies and key findings, and identify research gaps. **Method** : A scoping review was conducted following the guidelines of Arksey and O'Malley, Levac, and PRISMA-ScR. PubMed, Scopus, Web of Science, BVS Salud, and Epistemonikos (2015–2025) were searched in English and Spanish, limited to peer-reviewed, full-text publications. Theoretical and empirical studies that explicitly applied the PPCT model to postgraduate medical education were included. **Results** : Six relevant studies were identified. These range from conceptual frameworks to qualitative research and institutional interventions. The most explored bioecological levels were micro, meso, and macro, while the chronosystem appears in studies on curricular and contextual changes. The findings show that factors such as mentor relationships, inclusion, organizational culture, and policies influence residents' learning and well-being in a multiscalar manner. **Conclusion** : The PPCT constitutes a robust and versatile framework for analyzing postgraduate medical education, allowing us to understand learning as a complex and contextual phenomenon. However, its empirical use is still limited, which underscores the need for expanded research that integrates this approach into the design of health training policies and programs.

Keywords: Grounded Theory, Medical Education, Ecological Systems, Human Development, Built Environment, Learning.

Resumen.
Introducción: La formación médica de posgrado es una etapa decisiva para consolidar el profesionalismo clínico, competencias especializadas e identidad profesional. El entorno clínico —incluyendo tutores, normativas y cultura institucional— influye en el desarrollo del residente. La Teoría Bioecológica del Desarrollo Humano (TBEDH) de Bronfenbrenner, y su operacionalización en el modelo Proceso–Persona– Contexto–Tiempo (PPCT), ofrece un marco para comprender cómo múltiples niveles contextuales interactúan y condicionan la experiencia formativa. **Objetivo**: Mapear estudios que aplican la TBEDH en educación médica de posgrado, identificar niveles de análisis, describir metodologías y hallazgos clave, y detectar vacíos de investigación. **Método**: Se realizó una revisión de alcance (scoping review) siguiendo las directrices de Arksey y O'Malley, Levac y PRISMA-ScR. Se buscaron estudios en PubMed, Scopus, Web of Science, BVS Salud y Epistemonikos (2015–2025), en inglés y español, limitados a publicaciones revisadas por pares y con texto completo. Se incluyeron estudios teóricos y empíricos que aplicaran explícitamente el modelo PPCT en la educación médica de posgrado. **Resultados**: Se identificaron seis estudios relevantes. Estos abarcan desde marcos conceptuales hasta investigaciones cualitativas e intervenciones institucionales. Los niveles bioecológicos más explorados fueron micro, meso y macro, mientras que el cronosistema aparece en estudios sobre cambios curriculares y contextuales. Los hallazgos muestran que factores como relaciones con tutores, inclusión, cultura organizacional y políticas influyen de manera multiescalar en el aprendizaje y bienestar de los residentes. **Conclusión**: La TBEDH constituye un marco sólido y versátil para analizar la educación médica de posgrado, permitiendo comprender el aprendizaje como un fenómeno complejo y contextual. Sin embargo, su

uso empírico aún es limitado, lo que subraya la necesidad de ampliar investigaciones que integren este enfoque en el diseño de políticas y programas formativos en salud.

Palabras clave: Teoría Fundamentada, Educación Médica, Sistemas Ecológicos, Desarrollo Humano, Entorno Construido, Aprendizaje.

1. Introduction

Postgraduate medical training is a crucial stage in the development of clinical professionalism, the acquisition of specialized skills, and the consolidation of medical identity. In this process, the environment in which residents develop—hospitals, tutors, institutional regulations, and professional culture—plays a fundamental role in their professional development and psychosocial well-being. Understanding this environment from a systemic perspective allows us to identify multiple and hierarchical influences that impact training processes. This has been addressed with increasing interest through Bronfenbrenner's Bioecological Theory of Human Development (1).

Bioecological theory, conceived by Urie Bronfenbrenner, has recently been applied in medical education as an explanatory framework for analyzing the interactions between residents and their multiple training contexts—from direct relationships with mentors and patients (microsystem) to health policies and medical culture (macrosystem)(2). This perspective recognizes that the professional development of medical residents does not occur in isolation, but rather in a dynamic interaction with contextual, social, organizational, and temporal structures (3,4).

Despite its relevance, the explicit and systematic use of Bioecological Theory in postgraduate medical education research is still limited. Therefore, the present work aims to: (1) map the studies that have explicitly applied Bronfenbrenner's Bioecological Theory in postgraduate medical education contexts; (2) identify the bioecological levels of analysis (micro, meso, exo, macro and chronosystem) that have been considered in the study of clinical environments; (3) describe methodologies, conceptual frameworks and key findings related to resident professional development from an ecological perspective; and (4) identify gaps in the literature and opportunities for future health education research. (5)

Several investigations have highlighted the usefulness of the ecological approach to analyze the exhaustion (burnout) of residents(6), the role of academies of medical educators(7), and the inclusion of students with disabilities in medical education(4), considering the interaction between systems and their influence on the training experience. Furthermore, authors such as Fuller and Woods(8) and Munguiko et al.(9) emphasize that the integration of learning theories and ecological frameworks in training programs promotes a more humane, reflective and student-centered clinical environment.

The Bioecological Theory of Human Development (BETHD), proposed by Bronfenbrenner, constitutes a broad theoretical framework that explains human development as a result of the reciprocal interaction between the person and the different levels of their environment, from the microsystem to the macrosystem, also considering the temporal dimension (8). The PPCT (Process-Person-Context-Time) model emerges as an evolution and operationalization of this theory, providing an analytical structure that facilitates its empirical application. Thus, while BETHD offers the conceptual basis for understanding contextual and temporal influences on development, the PPCT model translates these principles into a methodological framework that integrates individual, contextual, structural and temporal factors, allowing for more precise and comparable research (8).

In this context, this study aims to systematize and critically analyze the use of Bioecological Theory in the literature on postgraduate medical education, in order to provide a comprehensive framework that strengthens educational practices, improves the learning experience of residents, and guides new lines of research.

2. Methods

A scoping review was conducted based on the methodology proposed by Arksey and O'Malley (10), expanded by Levac et al. (11), and following the PRISMA-ScR guidelines (12) for scoping reviews. This review was designed to map the available scientific literature on the explicit application of Bronfenbrenner's Bioecological Theory of Human Development in postgraduate medical training contexts, identify levels of bioecological analysis, synthesize key findings, and identify gaps in the health education literature.

Review question

How has Bronfenbrenner's Bioecological Theory been applied in the analysis of clinical and training environments in postgraduate medical education?

Search strategy

A systematic search was conducted in five databases: PubMed, Scopus, VHL Salud, Epistemonikos, and Web of Science. The search covered the period from January 2015 to August 7, 2025, considering publications in English and Spanish. Combinations of controlled and free terms were used, with Boolean operators, truncation (*), and quotation marks for exact phrases. In addition, filters were applied to limit the search to peer-reviewed publications available in full text (Table 1). Gray literature was not searched, but the reference lists of included studies were reviewed (snowballing) to identify additional potentially eligible articles. The inclusion criteria were:

- Theoretical studies, reviews or empirical research (qualitative, mixed or quantitative).
- Explicit application of the PPCT (Process–Person–Context–Time) model in the analysis of postgraduate medical educational contexts.
- Peer-reviewed publications, available in full text. Exclusion criteria.
- Exclusively clinical studies with no explicit link to educational processes.
- Duplicate, incomplete or articles without a clear methodological description.

Board 1. Matrix of strategies of search by bases of data.

Base of data	Syntax exact employee	Filters applied
Pub Med	("Bioecological Theory"[Title/Abstract] OR "Ecological Systems Theory"[Title/Abstract] OR Bronfenbrenner[Title/Abstract]) AND ("Human Development"[Title/Abstract] OR developmen-tal[Title/Abstract]) AND ("Medical Education"[Title/Abstract] OR "Clinical Learning Environment"[Title/Abstract] OR "Post-graduate Medical Education"[Title/Abstract] OR residency[Title/Abstract] OR "clinical training"[Title/Abstract] OR "clinical learning"[Title/Abstract])	Languages: English and Spanish; years: 2015–2025 ; *peer-reviewed* ; text complete
Scopus	TITLE-ABS-KEY("Bioecological Theory" OR "Ecological Systems Theory" OR Bronfenbrenner) AND TITLE-ABS-KEY("Hu- man Development" OR developmental) AND TITLE-ABS-KEY("Medical Education" OR "Clinical Learning Environment" OR "Postgraduate Medical Education" OR residency OR "clini-lime training" OR "clinical learning)	Languages: English and Spanish; years: 2015–2025 ; *peer-review wed*
Web of Science	TS=("Bioecological Theory" OR "Ecological Systems Theory" OR Bronfenbrenner) AND TS=("Human Development" OR developmental) AND TS=("Medical Education" OR "Clinical Learning Environment" OR "Postgraduate Medical Education"	Languages: English and Spanish; years: 2015–2025

	OR resi- dency OR "clinical training" OR "clinical learning)	
VHL Salud	("Bioecological Theory" OR "Ecological Systems Theory" OR Bronfenbrenner) AND ("Human Development" OR developmental) AND ("Medical Education" OR "Clinical Learning Environment" OR "Postgraduate Medical Education" OR residency OR "clinical training" OR "clinical learning)	Languages: English and Spanish; years: 2015–2025

3. Results

The review identified six key studies that explicitly apply Bronfenbrenner's Bioecological Theory to the analysis of postgraduate medical education. These works span different levels of the ecological model, methodologies, and medical specialties, contributing significantly to the understanding of clinical environments from an ecological perspective (Table 2).

Ellaway et al. (3) developed a conceptual article that explores the macro, exo, and chronosystem levels of medical education, proposing an ecological model to analyze and promote contextual change in training programs. The study, conducted in collaboration between Canada and the Netherlands, highlights how political, institutional, and temporal systems shape the training experience of medical trainees. This approach allows clinical curricula to be adapted to social, structural, and political changes, providing a systemic perspective that transcends the direct interaction of the resident with their immediate environment.

For their part, Gruppen et al. (13) offer a theoretical essay that incorporates all levels of the bioecological model to conceptualize learning environments in medical education. Their framework is based on an integrative theoretical review based on multiple currents such as ecological psychology, situated learning and sociomateriality theory. The resulting model distinguishes psychosocial (personal, social and organizational) and material (physical and virtual spaces) dimensions, providing a solid basis for redesigning more humane, inclusive and effective clinical environments for learning.

Nolan and Owen (14) conducted a qualitative study in the United Kingdom to analyze medical students' feedback on their experiences of equality, diversity, and inclusion in clinical settings. Through thematic analysis of interviews and focus groups, they identified structural and cultural barriers present at the micro, meso, exo, and macro levels of the ecological model. Their study shows how inequalities manifest simultaneously at multiple levels, affecting the resident's educational experience. The findings offer useful information for redesigning more inclusive and diversity-sensitive clinical curricula.

The study by Jones et al. (15), conducted in the United Kingdom, explores how the learning environment influences the well-being of medical students, using a qualitative methodology based on semi-structured interviews. The findings show that student well-being is profoundly affected by interpersonal, organizational, and cultural factors, which are distributed across the micro, meso, and macro levels of the bioecological model. Relationships with clinical supervisors, academic load, the emotional climate in hospitals, and the performance culture were identified as key determinants of well-being. The study proposes understanding well-being not only as an individual state, but as an ecological and contextual phenomenon, influenced by multiple interrelated systems. This perspective allows for the design of structural interventions aimed at improving both the training conditions and the mental health of future medical professionals.

In the two most recent studies, Zwemer et al.(7) in the United States implemented an institutional intervention based on Bronfenbrenner's Ecological Systems Theory to revitalize

participation in the Educators Academy, increasing event attendance from 30 to 1,000 participants through integrated actions across ecological levels, including regional in-person events, mentoring, regional liaisons, institutional support, virtual options, a cultural shift toward active engagement, and fostering shared leadership.

For their part, Kelly et al. (16) in Canada, through a qualitative study with semi-structured interviews with longitudinal clerkship students integrated in rural communities, identified that the learning experience was influenced by relationships with preceptors and multidisciplinary teams, community ties, limited clinical resources, geographic isolation and sociopolitical factors; these elements favored continuity, community integration and preparation for residency, demonstrating the formative value of this model for professional development and medical identity, as well as its potential to strengthen the rural health workforce.

4. Discussion

For decades, the assessment of social progress has prioritized economic indicators such as the Gross Domestic Product or GDP, relegating essential dimensions of human well-being. This reductionist view was challenged by Amartya Sen, who argued that development should be understood as the expansion of capabilities that enable people to lead lives they value (18–21). His capability approach incorporates not only material resources, but also functionings—health, education, nutrition—and the actual opportunities to achieve them (22). This approach led to the formulation of the Human Development Index (HDI), which integrates longevity, education, and income as a more comprehensive alternative to GDP (23), and opened the door to models that recognize the complexity of human development, such as Bronfenbrenner's Bioecological Theory of Human Development (BETHD) (24–25).

The bioecological model, initially conceived to overcome the limitations of experimental approaches in developmental psychology, places the individual within a network of interdependent systems: micro, meso, exo, macro, and chronosystems (26–28). In its evolution toward the PPCT (Process–Person–Context–Time) model, Bronfenbrenner incorporated a dynamic perspective that simultaneously considers individual characteristics, interactions, environments, and temporal changes (5, 8, 13). As represented in Figure 2, the findings demonstrate the simultaneous influence of micro, meso, exo, macro, and chronosystemic factors on the resident's training experience. This conceptual framework is especially valuable for analyzing medical education, given that clinical learning takes place in multiple, interactive, and constantly changing environments.

Table 2. Bioecological studies.

Author	Guy of study	Bioecological level	Methods	Key findings	Relevance to the clinical training
Ellaw ay (3)	Conceptual article	Macrosystem, exosistem and chronosystem	Theoretical synthesis on ecological systems	Proposes ecological model for contextual change	Allows you to adapt training programs to systemic changes and contextual .
Groups (17)	Theoretical essay	All levels	Theoretical review	Proposes to integrate ecological theory in the medical educational process.	Offers a robust conceptual framework to redesign clinical curricula more human.
Nolan & Owen (14)	Qualitative study	Micro, Meso, Exo, Macro	Qualitative analysis student feedback	Barriers to equality and diversity and inclusion occur at multiple levels.	Allows redesigning clinical curricula more inclusive and equitable
Jones, Fawns & Aitke n (15)	Article by opinion / framework theorist	Microsystem, Mesosystem, Exosystem. Macrosystem, Chronosistem	Reflective analysis based in Systems Theory Ecological	EST allows us to understand and articulate the interaction of individual, contextual, and structural factors that influence development; it facilitates the integration of findings from multiple studies and the generation of relevant research questions.	It promotes a comprehensive approach to the training of health professionals, fostering leadership skills, critical thinking, adaptation to changing contexts, and the ability to influence educational policies and practices.
Zwemer (7)	Technical report (institutional intervention)	Microsystem, Mesosystem, Exosystem, Macrosystem, Chronosystem	Medical education (multidisciplinary)	Implementing strategies based on Bronfenbrenner's Ecological Systems Theory to revitalize participation in the Educators Academy	Increasing event attendance from 30 to 1,000 participants through actions at all ecological levels: regional in-person events, mentoring, regional liaisons, institutional support, virtual options, cultural shift toward active engagement, focus on workshops, recognition, and shared leadership.
Kelly (16)	Qualitative research	Microsystem, Mesosystem, Exosystem, Macrosystem, Chronosystem	Family and rural medicine	Semi-structured interviews with integrated longitudinal clerkship (LIC) students in rural communities; reflective thematic analysis using the Bronfenbrenner framework	A learning experience influenced by relationships with preceptors, multidisciplinary teams, community ties, limited clinical resources, geographic isolation, and sociopolitical factors; it fosters continuity, community integration, and residency readiness.

Table 3. Evaluation of the methodological quality of the articles.

Article	Instrument	Result
Jones (15)	CASP (Critical Appraisal Ski-lls Programme - Qualitative)	Strengths: clear objective, theoretical coherence, practical relevance; Limitations: without empirical data, without systematic analysis; Overall value: High conceptual value, low generalization empirical.
Nolan (14)	CASP (Critical Appraisal Ski-lls Programme - Qualitative)	Strengths: clarity of objectives, coherence methodological, empirical support, practical relevance; Limitations: insufficient detail in sampling and reflexivity; Worth global: High quality methodological.
Groups (13)	SANRA (Scale for the Assessment of Narrative Review Articles)	Score 10/12 – High quality narrative, limitations in description and rigor methodological of search.
Ellaway (3)	SANRA (Scale for the Assessment of Narrative Review Articles)	Score 10/12 – High narrative quality, without explicit method of searching and selecting literature.
Kelly (16)	CASP Qualitative Checklist	Complies with all the methodological quality criteria for qualitative studies. The study presents a solid coherence between goals, design, methods and analysis, So as transparency in reflexivity and ethical considerations.
Zwemer (7)	SANRA (Scale for the Assessment of Narrative Review Articles)	SANRA Total Score: 10/12 High narrative quality, without explicit method of searching and selecting literature .

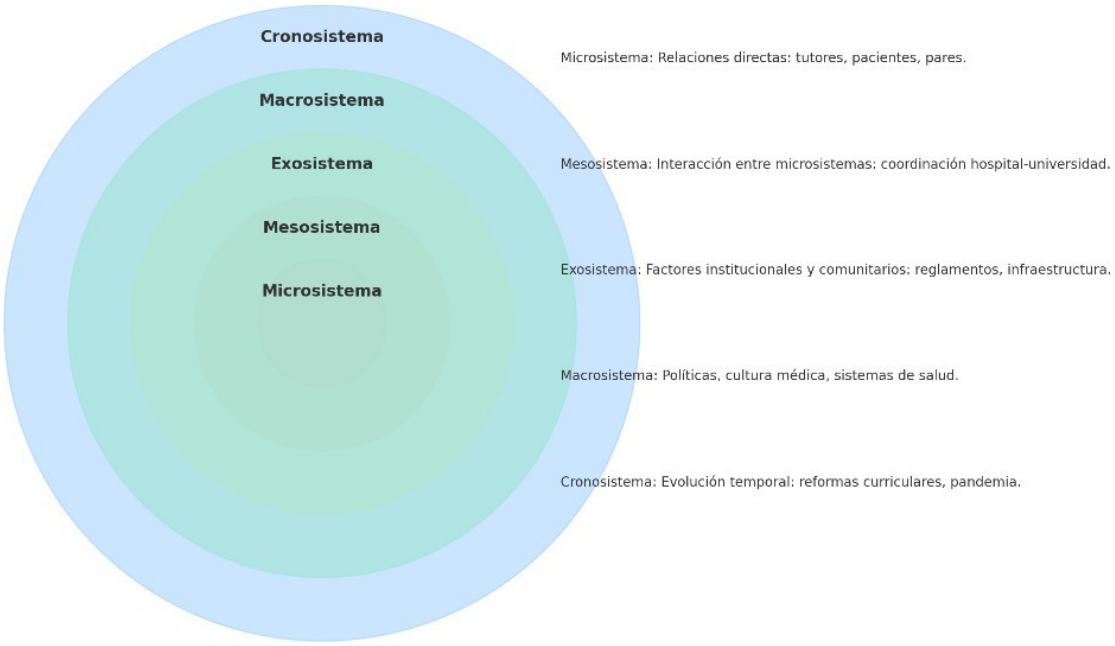

Figura 2. Ecological map of postgraduate medical education.

The microsystem configures direct interactions, such as the relationship with teachers, peers and patients (29), while the mesosystem articulates the coherence or dissonance between these immediate contexts (30). More distal factors, such as institutional policies or organizational culture, are framed in the exosystem and the macrosystem (29). The chronosystem, for its part, captures the effects of

curricular transitions, health crises or legislative changes over time (30). This approach allows mapping, with a structural lens, how an inadequate institutional climate, an authoritarian culture or social instability can affect student performance and well-being (31-32).

Evidence supports the usefulness of the bioecological model in medical education. Ellaway et al. (3) applied it to analyze student adaptation during clinical rotations, while Tong and An (30) used it to explore international education, highlighting how the coexistence of distinct—and sometimes conflicting—cultural systems shapes the training experience. Conceição et al. (33) documented that language barriers, discrimination, and lack of institutional support impact the emotional well-being and performance of Brazilian students in the US, and Xu and Tran (34) highlighted the role of the chronosystem in the adaptation of Chinese doctoral students to the disruption caused by the COVID-19 pandemic.

In the characterization of clinical learning environments, authors such as Roff et al. (35) have shown that variables such as teaching support, quality of feedback, and interpersonal respect are decisive for educational success. Exclusionary or abusive environments generate exhaustion, anxiety, and loss of motivation (36–38), which underscores the importance of addressing structural factors from the perspective of HRT to ensure healthy educational spaces.

Likewise, applications in the digital field are emerging. Boison (39) proposes a conceptual framework inspired by Bronfenbrenner to understand the interaction of actors in technology-mediated educational ecosystems, integrating skills, relationships, and institutional policies. Hayes et al. (5) add that the media and public policies, as components of the macrosystem, decisively influence health education strategies.

Bronfenbrenner's PPCT model allows us to break down complex cases of ethical conflict and professional behavior into their multiple contextual determinants. For example, imagine a resident faced with a superior's order to prematurely discharge a patient to "speed up" the service, against his or her clinical judgment. From the microsystem, the direct resident-mentor relationship (immediate hierarchical pressure) and the interaction with the patient intervene; in the mesosystem, the coherence (or lack thereof) between university standards and the hospital's care culture influences; in the exosystem, institutional policies such as bed overcrowding or lack of adequate supervision appear; while the macrosystem encompasses a traditional medical culture that prioritizes hierarchical obedience over professional autonomy. The chronosystem, for its part, incorporates the temporal dimension: the repetition of similar episodes throughout the residency can erode the original identity and values of the physician in training. This multilevel analysis clarifies why professional behavior cannot be assessed or modified in isolation from context, since "professionalism has no meaningful existence independent of the interactions that shape and give it meaning." Indeed, ignoring situational factors leads to the fundamental attribution error, that is, overestimating personal factors and underestimating contextual influences on resident behavior. Several studies highlight that the situation shapes most of the behaviors observed in training, such that acts considered "unprofessional" often reflect contextual tensions (excessive workload, values dilemmas, mixed messages from superiors) rather than a lack of individual ethics.

Taken together, the literature demonstrates that the TBEDH and the PPCT model offer a solid analytical platform for integrating individual, contextual, structural, and temporal factors in the study of learning and professional development in health sciences. Their convergence with the proposals of Sen (19-20), Nussbaum (22), and Anand (21) broadens the scope toward an ethical and political vision of human development, allowing for the design of public policies and educational systems that are more inclusive, culturally sensitive, and adapted to contemporary global challenges.

Analysis of ethical and professional conflict situations from a bioecological perspective

From this perspective, the bioecological approach not only analyzes but also offers avenues for resolving these recurring ethical and professional conflicts. Following the previous example, an intervention in the microsystem could consist of establishing spaces for ethical dialogue between residents and tutors, where these critical situations are openly discussed and collaborative solutions are sought (e.g., patient redistribution or safe discharge plans).

At the mesosystemic and exosystemic levels, the institution can implement protocols that balance care demands with patient safety and resident training, preventing the pressure for clinical productivity from generating ethical transgressions. At the macrosystem, fostering a culture that values transparency and learning from mistakes over punishment would help residents avoid feeling they must choose between their professional values and loyalty to the hierarchy. Finally, at the chronosystem, it is key to longitudinally monitor the moral development of physicians in training: through ongoing mentoring and periodic reflection, their professional identity is reinforced over time, helping them integrate their ethical convictions with actual clinical practices. In short, the bioecological perspective offers a "map" for understanding how a specific ethical conflict is co-created by the person and their environment, and guides interventions at all levels (from one-on-one interaction to institutional policies) to resolve it constructively. This contrasts with reductionist views that place sole responsibility on the individual; On the contrary, a systemic approach allows for the correction of underlying conditions that lead to unprofessional behavior (fatigue, overload, lack of supervision), thus promoting an environment where residents can perform in accordance with the ideals of the profession even under pressure.

Qualitative accounts from residents—and, to a lesser extent, their mentors—provide a vivid glimpse into how contextual factors, from the micro to the macro level, can foster or undermine professional behavior. In the user's hospital environment, several residents have recounted experiences that demonstrate this dynamic. For example, a second-year resident described how minor errors are disproportionately punished: "They expose us in front of everyone, take photos of our files, impose additional tasks on us during our breaks." These practices in the microsystem (public humiliation, arbitrary sanctions) generate a climate of fear and frustration that makes it difficult to exercise professionalism with integrity. Rigid hierarchy and normalized mistreatment emerge as macrosystemic elements in statements conveyed by tenured physicians to their trainees: "You are the scum of the scum... here you respect everything," reminding them of their subordinate position. This historically authoritarian culture, part of the macrosystem, erodes residents' professional self-esteem and validates symbolic violence as a teaching method. Residents describe how, under these conditions, the hospital becomes "a suffocating space, where one must survive rather than learn," due to 36-hour shifts, constant humiliation, and a lack of support. Consequently, many report a gradual loss of empathy and purpose, accompanied by symptoms of burnout and depression. "I'm broken, I don't smile anymore," confessed a former resident after months of sustained abuse. It is not surprising, then, that according to a national study, more than 80% of residents have experienced some form of abuse during their training, with detrimental effects on their emotional well-being and professional attitude. In fact, extreme cases such as suicidal ideation have been documented in residents who have been harassed at work, underscoring the urgency of addressing these contextual factors.

On the other hand, the narratives also illuminate contextual aspects that favor professionalism. Some residents highlight the positive impact of having accessible and supportive mentors (microsystem) or of rotations in rural communities where they felt useful and grounded (mesosystem–macrosystem), which reinforced their commitment to humanistic medicine. From the perspective of the mentors at our hospital, stories emerge that complement this picture. Several admit to feeling overwhelmed by the care load and administrative procedures (exosystem), which diminishes their capacity for educational support. “I would like to dedicate more time to teaching, but the system doesn't allow it,” commented one mentor off-the-record, alluding to the lack of

institutional support for teaching. This testimony reflects how a low institutional commitment to teaching (macrosystem) and the absence of incentives to serve as a mentor (exosystem) can weaken positive micro interactions between mentor and resident. In such contexts, even well-intentioned teachers operate "on automatic," prioritizing productivity over values formation, often in spite of themselves. Taken together, these narratives reveal a multi-causal pattern: work overload, vertical hierarchies, mistreatment, and a lack of resources (elements from the micro to the exosystem) conspire to erode professionalism, while social support, quality mentoring, and a sense of greater purpose act as protective factors. It is important to note that residents, when recounting their experiences, do not justify their own ethical lapses, but rather contextualize them: they understand that "most of the behaviors we observe are shaped by the situation."

Therefore, their testimonies do not seek to evade individual responsibility, but rather to call for changes in their environment that allow them to behave according to the professional standards they value. The lesson for medical education is clear: listening to these voices and analyzing their contexts (micro, meso, exo, macro) provides a deeper understanding of professional behaviors, informing interventions that address root causes and not just symptoms. As a recent statement from residents following a tragic event stated, "We don't want martyrs, we want justice and transformation." That is, they yearn for dignified training conditions where they can grow as integral professionals without sacrificing their health or their principles.

Educational interventions

- Ethical reflection workshops and case discussions (Microsystem): Periodic curricular spaces where residents and mentors jointly analyze real ethical dilemmas experienced in clinical practice. These ethics rounds or humanism seminars allow physicians in training to express their concerns, confront value conflicts (e.g., honesty vs. hierarchical obedience), and practice shared decision-making. The literature suggests that methods such as group case discussions, guided reflection, and values-focused morbidity and mortality rounds are effective tools for teaching professionalism. In a safe environment, residents can analyze why certain behaviors are considered professional or unprofessional, understanding the weight of context in these situations. This develops their ethical judgment and reinforces professionally appropriate behaviors in daily clinical practice.
- Structured mentoring programs (Microsystem–Mesosystem): Assign each resident one or more academic mentors, distinct from their immediate superiors, with whom they meet regularly for professional guidance and psychosocial support. The mentor, if properly trained, serves as a positive role model and can mediate when conflicts arise in the work environment. Well-structured mentoring creates a mesosystemic bridge between the healthcare and academic settings, ensuring consistency in educational messages. Furthermore, it provides residents with a trusting relationship in which to discuss difficulties, reflect on their medical identity, and receive constructive feedback. Previous studies show that the mentor figure is key to professional socialization and the transmission of medical values, especially in complex clinical settings. Institutionalizing mentoring sessions (e.g., monthly meetings with defined objectives) would help counteract the feeling of anonymity or abandonment that many residents report, reinforcing their professional commitment even in adverse contexts.
- Curriculum redesign with an ecological approach (Exosystem–Macrosystem): Review the residency curriculum to integrate experiences and content that explicitly address the different contextual levels of professional development. On the one hand, incorporating training modules on health systems, inequities, and social responsibility (macrosystem level) will sensitize residents to their role in the community and the sociopolitical context of their practice. On the other hand, implementing longitudinal rotations in community or interdisciplinary settings (mesosystem) can foster a broader and more humane view of care, as demonstrated by the rural clerkship program, in which students achieved greater community integration and preparation for residency, strengthening their professional identity. Likewise, it is recommended to align

institutional policies with educational objectives: for example, guaranteeing protected time for teaching and self-study within the shift (exo/meso), limiting on-call hours according to international standards, and establishing learning environment committees to continuously monitor residency conditions. A benchmark in this regard is the work of Gruppen et al., who propose conceptualizing learning environments by addressing all levels of the bioecological model to design more human-centered curricula. This implies, in practical terms, flexible curricula that adapt to contextual changes (chronosystem)—for example, post-pandemic adjustments in teaching strategies—and that promote an organizational culture of respect and continuous learning (macrosystem). Such "ecological" curricular redesigns seek to ensure that the training system, as a whole, provides the conditions for professionalism to flourish: more humane, inclusive, and culturally sensitive curricula, as the findings of this review suggest.

The methodological quality of the included articles was assessed using standardized instruments based on the type of study. In the case of Derek Jones et al. (15), assessed using the CASP Qualitative Checklist, the strengths identified were a clearly defined objective, theoretical coherence, and practical relevance of the findings. However, a lack of empirical data and systematic analysis was observed, limiting the generalization of the results, giving it an overall value of high conceptual value but low empirical applicability. In Helen Anne Nolan et al. (14), also assessed using CASP, the clarity of the objectives, methodological coherence, empirical support, and practical relevance were highlighted. The limitations focused on the lack of sufficient detail in the sampling and in the reflection on the role of the researcher, concluding that the study presents a high methodological quality. Regarding Larry D. Gruppen (13), the application of the SANRA instrument yielded a score of 10/12, reflecting high narrative quality, although with limitations in the description of the bibliographic search process and methodological rigor. Similarly, Rachel H. Ellaway (3), also evaluated with SANRA, obtained 10/12 points, highlighting the quality of the narrative, but without an explicit method of searching and selecting literature. The work of Kelly et al. (16), assessed with the CASP Qualitative Checklist, met all the criteria of methodological quality for qualitative studies, showing solid coherence between objectives, design, methods and analysis, as well as transparency in reflexivity and adequate ethical management. Finally, Zwemer et al. (7), evaluated with SANRA, achieved a total score of 10/12, indicating high narrative quality, but with the absence of an explicit method of searching and selecting literature (see Table 2).

5. Conclusions

- This scoping review demonstrates that the Bioecological Theory of Human Development (BETHD) and its operationalization through the Process-Person-Context-Time (PPCT) model constitute a solid and versatile theoretical framework for the analysis of educational processes in postgraduate medical education. Its ability to integrate individual, contextual, structural, and temporal dimensions allows us to understand clinical training as a complex, dynamic phenomenon conditioned by multiple interrelated systems.
- The reviewed studies show that this perspective facilitates the identification of barriers and facilitators to resident learning, well-being, and inclusion, as well as the design of more equitable and culturally sensitive interventions. However, the explicit incorporation of EHRB in empirical research is still limited, underscoring the need to expand its use to strengthen the evidence base and guide educational policies in line with contemporary health challenges.
- The integration of this ecological approach with the capabilities paradigm proposed by Sen and Nussbaum broadens the horizon toward a medical education committed to integral human development, social justice, and adaptation to constantly changing global contexts. In this sense, the TBEDH and the PPCT model offer conceptual and methodological tools to explain how environments—from macro-, meso-, and microsystems—influence the professional development of physicians in training and, ultimately, the quality of graduates. Furthermore, they constitute an ideal basis for designing empirical studies that evaluate the impact of these environments on educational processes and the training quality of future

health professionals. Figure 2 summarizes the levels and contexts identified, emphasizing the value of the bioecological model in guiding educational policies.

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