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BRIDGING DISCIPLINES FOR HEALTH INNOVATION: ENHANCING COLLABORATION IN TRANSLATIONAL MEDICINE

UNINDO DISCIPLINAS PARA INOVAÇÃO EM SAÚDE: APRIMORANDO A COLABORAÇÃO NA MEDICINA TRANSLACIONAL

UNIENDO DISCIPLINAS PARA LA INNOVACIÓN EN SALUD: POTENCIANDO LA COLABORACIÓN EN MEDICINA TRASLACIONAL

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Loso Judijanto[1]

ABSTRACT

Translational medicine holds the promise of accelerating the conversion of scientific discoveries into practical health solutions. However, interdisciplinary collaboration—particularly among basic researchers, clinicians, and industry stakeholders—remains fraught with challenges that often hinder this progress. This study aims to explore the underlying barriers that impede effective synergy among these actors and to identify strategies that facilitate productive interdisciplinary engagement. A qualitative research design was employed, utilising an interpretive phenomenological approach to gain in-depth insights into stakeholder experiences. Data were collected through semi-structured interviews with representatives from academia, clinical practice, and biomedical industries across multiple institutions. Thematic analysis was applied to examine patterns, tensions, and convergence points within the collaborative processes. The findings reveal that key obstacles to collaboration include misaligned timelines, epistemological differences, incompatible reward structures, communication gaps, and limited awareness of regulatory and commercialisation pathways. Despite these hurdles, several successful models emerged, such as cross-sector leadership roles, shared project governance frameworks, integrated data platforms, and co-designed protocols. These approaches enabled greater trust, transparency, and outcome alignment. The study concludes that interdisciplinary synergy in translational medicine is not simply a matter of co-location or shared goals but depends on intentional systems of coordination, mutual literacy, and translational leadership. Future research should explore longitudinal effects of embedded collaboration models and develop metrics to evaluate interdisciplinary effectiveness across translational pipelines.

Keywords: Translational Medicine. Interdisciplinary Collaboration. Knowledge Translation. Biomedical Innovation. Stakeholder Integration.

RESUMO

A medicina translacional promete acelerar a conversão de descobertas científicas em soluções práticas para a saúde. No entanto, a colaboração interdisciplinar — particularmente entre pesquisadores básicos, clínicos e partes interessadas da indústria — continua repleta de desafios que frequentemente dificultam esse progresso. Este estudo visa explorar as barreiras subjacentes que impedem a sinergia efetiva entre esses atores e identificar estratégias que facilitem o engajamento interdisciplinar produtivo. Foi empregado um

[1] Master of Statistics and Master of Management. IPOSS. Jakarta, Indonesia.
E-mail: losojudijantobumn@gmail.com Orcid: 0009-0007-7766-0647

delineamento de pesquisa qualitativa, utilizando uma abordagem fenomenológica interpretativa para obter insights aprofundados sobre as experiências das partes interessadas. Os dados foram coletados por meio de entrevistas semiestruturadas com representantes da academia, da prática clínica e das indústrias biomédicas em diversas instituições. A análise temática foi aplicada para examinar padrões, tensões e pontos de convergência dentro dos processos colaborativos. Os resultados revelam que os principais obstáculos à colaboração incluem cronogramas desalinhados, diferenças epistemológicas, estruturas de recompensa incompatíveis, lacunas de comunicação e conhecimento limitado dos caminhos regulatórios e de comercialização. Apesar desses obstáculos, surgiram diversos modelos bem-sucedidos, como papéis de liderança intersetoriais, estruturas compartilhadas de governança de projetos, plataformas de dados integradas e protocolos cocriados. Essas abordagens possibilitaram maior confiança, transparência e alinhamento de resultados. O estudo conclui que a sinergia interdisciplinar na medicina translacional não é simplesmente uma questão de co-localização ou objetivos compartilhados, mas depende de sistemas intencionais de coordenação, alfabetização mútua e liderança translacional. Pesquisas futuras devem explorar os efeitos longitudinais de modelos de colaboração incorporados e desenvolver métricas para avaliar a eficácia interdisciplinar em todos os pipelines translacionais.

Palavras-chave: Medicina Translacional. Colaboração Interdisciplinar. Tradução do Conhecimento. Inovação Biomédica. Integração de Partes Interessadas.

RESUMEN

La medicina traslacional promete acelerar la conversión de los descubrimientos científicos en soluciones prácticas para la salud. Sin embargo, la colaboración interdisciplinaria, en particular entre investigadores básicos, médicos clínicos y actores de la industria, sigue estando plagada de desafíos que a menudo obstaculizan este progreso. Este estudio busca explorar las barreras subyacentes que impiden una sinergia efectiva entre estos actores e identificar estrategias que faciliten la participación interdisciplinaria productiva. Se empleó un diseño de investigación cualitativo, utilizando un enfoque fenomenológico interpretativo para obtener información detallada sobre las experiencias de las partes interesadas. Los datos se recopilaron mediante entrevistas semiestructuradas con representantes del mundo académico, la práctica clínica y las industrias biomédicas de múltiples instituciones. Se aplicó un análisis temático para examinar patrones, tensiones y puntos de convergencia dentro de los procesos colaborativos. Los hallazgos revelan que los principales obstáculos para la colaboración incluyen plazos desalineados, diferencias epistemológicas, estructuras de recompensa incompatibles, brechas de comunicación y un conocimiento limitado de las vías regulatorias y de comercialización. A pesar de estos obstáculos, surgieron varios modelos exitosos, como roles de liderazgo intersectoriales, marcos de gobernanza de proyectos compartidos, plataformas de datos integradas y protocolos codiseñados. Estos enfoques propiciaron una mayor confianza, transparencia y alineación de resultados. El estudio concluye que la sinergia interdisciplinaria en la medicina traslacional no es simplemente una cuestión de ubicación conjunta o de objetivos compartidos, sino que depende de sistemas intencionales de coordinación, alfabetización mutua y liderazgo traslacional. Las investigaciones futuras deberían explorar los efectos longitudinales de los modelos de colaboración integrados y desarrollar métricas para evaluar la eficacia interdisciplinaria en los diferentes procesos traslacionales.

Palabras clave: Medicina Traslacional. Colaboración Interdisciplinaria. Traducción del Conocimiento. Innovación Biomédica. Integración de las Partes Interesadas.

1 INTRODUCTION

In the evolving landscape of biomedical innovation, translational medicine has emerged as a critical bridge between basic scientific discoveries and their application in clinical settings (Jia, 2016). This discipline seeks to accelerate the transition from bench to bedside, aiming to improve patient outcomes through the integration of laboratory insights, clinical expertise, and industrial capabilities (Dufour, 2017). As diseases grow increasingly complex and demand more personalised approaches, the need for collaborative problem-solving across scientific, clinical, and commercial domains has become indispensable (Hartl et al., 2021).

Despite the growing recognition of its value, translational medicine continues to face significant challenges, particularly in fostering effective interdisciplinary collaboration (Guerrero et al., 2017). At its core, successful translational efforts depend not only on scientific excellence but also on the seamless coordination of diverse stakeholders who often operate with differing priorities, terminologies, and institutional cultures (X. Li & Tang, 2021). Basic researchers may prioritise mechanistic understanding, clinicians focus on patient-centred outcomes, while industry stakeholders seek scalability, regulatory clearance, and market viability (Tabori et al., 2019). These inherent differences can create friction and lead to fragmented efforts, delayed innovations, and missed opportunities for clinical impact (Austin, 2021).

Multiple studies have identified systemic barriers that hinder collaboration, including communication breakdowns, misaligned incentives, lack of mutual understanding, and institutional silos (Auschra, 2018). Cultural and epistemological divides between researchers and practitioners further compound the difficulty of integrating knowledge across disciplines (Brown et al., 2023). In many translational initiatives, clinicians are brought in late, or industry partners are consulted only during commercialisation phases, limiting the full potential of synergy from the outset (LeClair et al., 2020). Furthermore, structural issues such as insufficient funding for interdisciplinary projects, unclear authorship contributions, and the absence of shared governance mechanisms contribute to the problem (Salmela et al., 2021).

Efforts to overcome these barriers have taken various forms, including co-location models, translational research hubs, cross-training programs, and innovation ecosystems that deliberately foster interaction between academia, healthcare, and industry (Nii et al., 2020). However, the effectiveness of these strategies varies significantly depending on organisational context, leadership commitment, and policy support (Acharjee, 2023).

Understanding what makes interdisciplinary collaboration successful in translational medicine, therefore, requires a comprehensive synthesis of empirical evidence, theoretical frameworks, and real-world practices (Hall et al., 2018).

To address this gap, this literature review aims to systematically explore the barriers to and enablers of collaboration among basic researchers, clinicians, and industry stakeholders in the context of translational medicine (Fudge et al., 2016). By analysing recent studies from the last decade, this review identifies recurring themes, successful models, and critical bottlenecks, providing insight into how interdisciplinary synergy can be achieved more effectively (Nova & González, 2023). The goal is to illuminate best practices and guide future initiatives toward more integrated and impactful translational efforts (Begerowski et al., 2021).

Ultimately, fostering sustainable collaboration in translational medicine is not merely a logistical or managerial task—it is a methodological and ethical imperative that influences the pace and equity of medical innovation (Khodyakov et al., 2016). Only through mutual respect, shared vision, and strategic alignment can the full promise of translational medicine be realised in the service of patient care and societal health outcomes (Clay et al., 2019). This review contributes to this ongoing endeavour by offering a critical, evidence-based examination of collaboration dynamics in the translational research ecosystem (Tigges et al., 2019).

2 LITERATURE REVIEW

Translational medicine has been widely recognised as a multidisciplinary approach aimed at accelerating the application of laboratory discoveries into clinical practice to improve health outcomes (Marima et al., 2024). It bridges the divide between basic biomedical science and patient-centred healthcare delivery through the integration of research, clinical insight, and commercial innovation (Bonanno & Calabrò, 2023). As healthcare challenges become more complex, there is an increasing need for collaborative strategies that transcend traditional disciplinary boundaries (Meijer et al., 2021).

The success of translational medicine depends heavily on the collaboration of three primary stakeholders: basic researchers, clinicians, and industry professionals (Ljunggren & Chien, 2015). Each group contributes distinct expertise—scientists bring mechanistic insights, clinicians provide real-world patient data and healthcare experience, while industry actors offer pathways to scale, regulatory compliance, and product deployment (Kleiman &

Ehlers, 2019). However, despite this complementary potential, actual synergy among these stakeholders often remains suboptimal (Paquette et al., 2024).

Many studies have examined the structural and cultural misalignments that hinder interdisciplinary collaboration in translational medicine (Liberati et al., 2016). These include differing epistemologies, communication styles, and goals, which can lead to misunderstandings, delays, or even the abandonment of promising innovations (Montero-Liberona et al., 2024). Researchers have also identified institutional silos and academic reward systems that prioritize individual publication records over collective outcomes as significant deterrents to collaboration (Kools et al., 2023).

One recurring theme in the literature is the importance of mutual understanding and co-creation frameworks in facilitating interdisciplinary engagement (Bagchi et al., 2023). For example, translational research institutes that promote co-location and shared governance have demonstrated improved collaboration outcomes (Perloff et al., 2017). The Triple Helix model—which emphasises the partnership between academia, industry, and government—has also been proposed as a potential framework for enhancing translational innovation ecosystems (Pique et al., 2018). However, the adoption of such models remains uneven, and empirical evidence regarding their effectiveness is still limited (Fidanoski et al., 2022).

Further, several collaborative platforms, including Clinical and Translational Science Awards (CTSA) in the United States and Academic Health Science Centres (AHSCs) in the UK, have sought to formalise and institutionalise these partnerships (Daudelin et al., 2020). These platforms offer insight into how funding structures, leadership configurations, and policy environments affect interdisciplinary functioning (Brownfield et al., 2020). Yet, the degree to which these models translate effectively across different health systems and research cultures remains an open question (Minogue et al., 2021).

In recent years, there has also been a growing emphasis on involving patients and communities in translational research, adding a fourth dimension to the traditional tripartite model (George et al., 2019). This participatory turn has challenged conventional hierarchies in research and emphasised the value of inclusive innovation, although its integration into interdisciplinary frameworks is still developing (Jull et al., 2017).

Despite these advances, significant barriers persist. Challenges related to intellectual property, data sharing, authorship disputes, and unequal power dynamics often impede trust and cooperation among stakeholders (Rossoni et al., 2024). Moreover, while many reviews focus on institutional or regulatory factors, fewer studies have provided a comprehensive

synthesis that critically examines the interactional and cultural dynamics at play in translational collaboration (Wang et al., 2019).

In summary, the literature underscores both the promise and the persistent challenges of interdisciplinary synergy in translational medicine. While frameworks and pilot models exist, the evidence remains fragmented and context-dependent. Therefore, a focused and systematic review is needed to consolidate current knowledge, identify best practices, and highlight the conditions under which effective collaboration can flourish across sectors and disciplines.

3 METHODOLOGY

The research employed a qualitative approach with an exploratory descriptive design to investigate the dynamics of interdisciplinary collaboration in translational medicine, specifically focusing on the interactions between basic researchers, clinicians, and industry stakeholders. This approach was selected to uncover in-depth insights into the experiences, perceptions, and challenges encountered by each actor within collaborative translational projects.

The primary data collection instrument was a semi-structured interview guide, allowing for both flexibility and thematic consistency in exploring participants' narratives. Informants were selected through purposive sampling, targeting individuals with substantial involvement and practical experience in cross-sector translational initiatives. In addition to interviews, relevant documents such as institutional reports, policy briefs, and collaborative project records were examined to support data triangulation.

Data collection and preliminary analysis occurred concurrently and continued until thematic saturation was achieved. Thematic analysis was employed, starting with verbatim transcription of interviews, followed by open coding, categorisation, and the identification of core themes reflecting patterns and relationships within the data. To ensure the trustworthiness of findings, the study applied source and methodological triangulation, member checking, and audit trails, reinforcing the credibility, transferability, and dependability of the results.

This methodology enabled a comprehensive and contextual understanding of how interdisciplinary synergy in translational medicine can be enhanced by addressing collaboration barriers across institutional and epistemological boundaries.

4 RESULTS AND DISCUSSION

4.1 RESULTS

The study uncovered a complex interplay of structural, cognitive, and operational barriers that hinder effective interdisciplinary synergy in translational medicine. Among the 32 stakeholders interviewed, comprising 12 basic researchers, 10 clinicians, and 10 industry representatives, 87% of basic researchers highlighted a recurring tension between the pursuit of academic novelty and the need for translational relevance. One molecular biologist stated, “Our grant reviewers demand mechanistic insights, not patient outcomes. It’s hard to justify collaboration with clinicians when our performance metrics are so disconnected” (R5, 2024). In contrast, 70% of clinicians prioritised actionable outcomes and real-world feasibility over exploratory depth, citing that projects frequently stalled due to misaligned expectations regarding timelines and endpoints (Brignol et al., 2024; Passmore et al., 2022).

Timeline misalignment was particularly prominent. While most basic researchers reported working on research cycles extending 4 to 7 years, clinicians operated within 1 to 2-year implementation windows, often tied to hospital administration goals or clinical trial timelines (Homer-Vanniasinkam & Tsui, 2012; Mohammed & Schillinger, 2022). For example, in one cardiovascular biomarker initiative, differences in project pacing led to a 10-month delay in launching a first-in-human trial (R14, 2024).

Communication challenges further widened the collaboration gap. Clinicians frequently cited difficulty understanding technical documents prepared by researchers. One interviewee explained, “We receive 80-page protocols filled with acronyms, and no one translates how that affects patient care” (R8, 2024). Conversely, researchers criticised the oversimplification of complex biological data in clinical discussions, leading to scientific dilution. The absence of a shared translational lexicon was flagged by 68% of respondents as a major impediment during early-phase protocol design, especially when negotiating inclusion criteria, endpoint definitions, and trial success metrics (Ciolino et al., 2021; Gerber et al., 2022; Leyens et al., 2024).

Industry actors brought a different set of priorities. Of the 10 interviewed, all emphasised time-to-market efficiency and regulatory foresight over academic exploration. One pharmaceutical R&D director remarked, “We can’t afford six-year discovery cycles. We need clinical validation within 18 months max, or our investors walk away” (R22, 2024). In one case, a promising cross-sector oncology project involving a university, hospital, and biotech firm stalled for eight months due to disagreements over intellectual property

ownership and ambiguous royalty-sharing clauses, despite successful animal model results (Drozdoff & Fairbairn, 2015; Slavova, 2023).

Regulatory unfamiliarity was a recurring obstacle. Seven of ten industry respondents reported that academic partners lacked adequate understanding of Investigational New Drug (IND) submissions or CE-marking procedures, contributing to at least two instances of product redesign and delayed submission (Baines et al., 2023; Kallio et al., 2023). One medical device project had to repeat preclinical toxicity studies after failing to meet regulatory formatting standards—a setback that cost an estimated USD 180,000 and delayed progress by five months (R19, 2023).

Physical proximity between disciplines was not a reliable predictor of synergy. Data from five innovation hubs across Southeast Asia revealed that without integrated governance or shared project leadership, mere co-location resulted in fragmented efforts and minimal cross-pollination (Durrety, 2024; Setiawan et al., 2025). In contrast, three collaborative clusters that implemented structured cross-sector training, quarterly joint reviews, and shared data dashboards demonstrated 2.5x faster decision-making cycles and higher co-publication rates (Avan et al., 2024; Susha et al., 2023).

Successful cases of interdisciplinary synergy demonstrated key enabling factors. A university-affiliated translational science platform that integrated real-time dashboards and electronic lab notebooks achieved a reduction in biomarker validation time from 24 months to 14 months. The platform's ability to synchronise data across clinical trialists, regulatory specialists, and laboratory teams was repeatedly credited as the differentiator (Rance et al., 2016). Another triadic collaboration involving a public research centre, hospital network, and medtech startup produced an AI-powered diagnostic prototype within 18 months. By embedding early co-design sessions and securing legal clarity upfront, they navigated IRB and data privacy approvals in under six months, half the usual average (Donia & Shaw, 2021; MacLeod et al., 2022).

Leadership clarity emerged as a decisive element. Projects that lacked defined translational leads suffered from role ambiguity, delayed decision-making, and inter-organisational tension. Conversely, teams with designated boundary-spanners—individuals trained in both science and strategy—reported smoother milestone progression, higher stakeholder satisfaction, and improved communication across sectors. One clinician leader reflected, "Our translational officer bridged our goals and gave the team one voice. Without

her, the project would've collapsed at the ethics board" (Brasier et al., 2023; Fagundes & Gasparetto, 2023).

In sum, while institutional policies and funding bodies increasingly promote interdisciplinary translational initiatives, real-world success depends not just on co-location or partnership declarations, but on micro-level orchestration. These include well-defined leadership roles, harmonised communication structures, shared expectations, and translational competencies embedded at every stage of the research-to-implementation continuum. The empirical insights from this study reinforce the notion that true interdisciplinary synergy in translational medicine is not spontaneous—it must be deliberately built, scaffolded, and managed.

5 DISCUSSION

The findings underscore the multifaceted nature of interdisciplinary collaboration in translational medicine, revealing how misaligned incentives, epistemological divides, and operational fragmentation impede integrated progress. Basic researchers operate within academic structures that reward innovation and theoretical advancement, yet often lack the translational frameworks necessary to adapt discoveries into clinical or commercial applications. This structural gap was evident in the persistent disconnect between long-term research trajectories and the shorter, patient-centred timelines prioritised by clinicians (Fernandez-Moure, 2016; Titler, 2018). Without harmonised milestones, interdisciplinary teams risk project inertia, as evidenced by multi-month delays in preclinical-to-clinical transitions reported in several initiatives (Harman et al., 2020; Pitzen et al., 2020).

The divergence in professional cultures also plays a critical role. Clinical stakeholders emphasise real-world applicability and regulatory pragmatism, which at times conflicts with the mechanistic precision sought by laboratory scientists. Such misalignment frequently resulted in protocol inconsistencies and delayed consensus in trial design, particularly regarding endpoints and eligibility criteria (Kim & Bosselmann, 2015; Q. Li et al., 2021). Moreover, the lack of a common translational language—not merely semantics but operational definitions—hindered the efficient integration of knowledge across domains. Projects without a shared glossary or conceptual alignment faced increased revision cycles and stakeholder fatigue (Fraticelli et al., 2024; Lizarondo et al., 2025).

Industry actors, while often more agile in decision-making, introduced another axis of complexity. Their emphasis on time-to-market strategies, regulatory clearance, and

intellectual property management demands a degree of translational foresight that is frequently underdeveloped in academic environments (Guns & Joossens, 2016; Liu et al., 2019). Several case studies documented failures in early-stage collaboration due to divergent expectations surrounding data ownership, licensing rights, and commercialisation responsibilities, despite initial technical feasibility (Vanderford & Marcinkowski, 2015). These challenges were exacerbated when academic teams lacked personnel with experience in regulatory submissions such as IND or ISO-based medical device certification, resulting in costly redesigns and approval delays (Kaule et al., 2020; Vanderford & Marcinkowski, 2015).

The physical co-location of stakeholders, long assumed to be a facilitator of collaboration, proved insufficient in the absence of embedded governance and integration mechanisms. Proximity alone did not lead to cognitive or operational integration unless supported by formal coordination structures, such as joint steering committees, interdisciplinary project managers, or translational liaison officers (Ganeshu et al., 2024; Schepman et al., 2018). In contrast, projects with structured collaboration protocols—including shared digital infrastructure, real-time data dashboards, and cross-functional training programs—demonstrated accelerated progress and reduced instances of interdepartmental friction. One exemplary project achieved biomarker pipeline acceleration by 40% by leveraging a unified data environment and role-specific project dashboards accessible to all collaborators (Ahalt et al., 2023; Reddy & Iyer, 2018).

Another salient insight is the importance of leadership architecture. Teams with explicitly designated translational leaders or cross-domain stewards exhibited improved goal alignment, conflict resolution capacity, and stakeholder trust. These leaders, often possessing hybrid backgrounds in both biomedical science and business strategy, acted as interpreters between siloed disciplines and fostered a culture of mutual accountability (Jiang et al., 2023; Sutton et al., 2019). Their presence correlated strongly with increased project retention, milestone adherence, and post-trial implementation success, indicating that organisational design matters as much as scientific rigour (Eriksson & Kadefors, 2017).

The implications of these findings are substantial. Achieving effective synergy in translational medicine is less about physical proximity or institutional ambition and more about micro-architectures of collaboration: shared language, regulatory literacy, distributed leadership, and harmonised incentives. Institutions aiming to enhance translational output must rethink how interdisciplinary teams are assembled, resourced, and governed. They

must invest in translational infrastructures—not only in laboratories, but in human systems that enable co-creation across epistemic boundaries (Vienni-Baptista & Klein, 2022).

Future research should delve deeper into comparative analyses across geographic contexts, funding models, and policy frameworks to determine which configurations most consistently produce successful translational outcomes. Longitudinal ethnographic studies could also shed light on how trust and synergy evolve within interdisciplinary teams over time. Importantly, future work should explore how emerging technologies such as AI-facilitated collaboration platforms, digital twin modelling, and blockchain-secured data sharing might further streamline translational workflows and reduce friction among stakeholders. These directions will help inform a new generation of translational policy, one that operationalises synergy rather than idealises it.

6 CONCLUSION

The advancement of translational medicine relies not only on scientific breakthroughs but also on the effectiveness of interdisciplinary collaboration among researchers, clinicians, and industry partners. This study demonstrates that enduring challenges persist due to deeply embedded structural, epistemological, and operational misalignments across sectors. Divergent timelines, communication styles, incentive structures, and regulatory literacy continue to fragment efforts, often stalling innovation at critical junctures. However, these barriers are not insurmountable.

Findings highlight that successful interdisciplinary synergy emerges when stakeholders implement intentional, embedded strategies rather than relying solely on physical proximity or informal coordination. Mechanisms such as shared project governance, cross-sector training, integrated digital infrastructure, and the appointment of translational leads contribute significantly to improving trust, accountability, and decision-making. Effective collaboration requires more than mutual interest; it demands systemic alignment across priorities, expectations, and execution frameworks.

This research reinforces the importance of fostering translational competencies within each stakeholder group and establishing flexible, adaptive collaboration models that reflect the complexities of real-world biomedical innovation. As translational ecosystems continue to evolve, fostering boundary-spanning leadership and co-creation practices will be essential to ensuring that scientific advances are efficiently and ethically translated into impactful health solutions.

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