Review article

Historical analysis and social and health impact of fentanyl use in Colombia

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SUMMARY

Introduction: Fentanyl, a synthetic opioid up to 100 times more potent than morphine, has ignited a global public health crisis. In Colombia, its increasing diversion from the medical system to illicit markets represents an emerging threat that demands in-depth analysis. **Purpose:** The objective of this research was to conduct a comprehensive analysis of the fentanyl phenomenon in the country, covering its history, current socio-health impact, and the systemic failures that facilitate its spread. **Methodology:** A qualitative methodology was employed, combining narrative documentary analysis with interviews of key informants directly involved in the legal control and institutional response to the opioid. **Results:** The results reveal that Colombia is in an early phase, defined by pharmaceutical diversion rather than clandestine production. A complex trafficking network exists, involving both legal and illegal actors, with hospitals and clinics being the primary point of leakage according to 67% of those interviewed. This diversion causes a severe health impact, including deaths by overdose (a link made by 78% of experts), and disproportionately affects at-risk youth (44%) and marginalized communities (33%). **Conclusions:** The study concludes that this problem is a symptom of deep-seated institutional flaws and social vulnerabilities. It highlights a critical window of opportunity to act, making a comprehensive response that combines public health strategies with the rigorous strengthening of controls imperative to contain the threat and prevent an escalation of the crisis.

Keywords: Fentanyl; illicit trafficking; non-medical use; overdose; pharmaceutical diversion; public health; social vulnerability.

RESUMEN

Análisis histórico e impacto social y sanitario del consumo del fentanilo en Colombia

Introducción: El fentanilo, un opioide sintético hasta 100 veces más potente que la morfina, ha provocado una crisis de salud pública global. En Colombia, su desvío desde el sistema médico hacia mercados ilícitos constituye una amenaza emergente que requiere un análisis profundo. **Objetivo:** Esta investigación tuvo como objetivo analizar integralmente el fenómeno en el país, abarcando su historia, impacto

sociosanitario y las fallas sistémicas que facilitan su propagación. **Metodología:** Se utilizó una metodología cualitativa que combinó análisis documental narrativo y entrevistas a informantes clave directamente involucrados en el control legal y la respuesta institucional al opioide. **Resultados:** Los resultados revelan que Colombia está en una fase inicial, definida por el desvío farmacéutico en lugar de la producción clandestina. Existe una compleja red de comercialización con actores tanto legales como ilegales, siendo los hospitales y clínicas el principal punto de fuga según el 67% de los entrevistados. Este desvío provoca un grave impacto sanitario, incluyendo muertes por sobredosis (vinculado por el 78% de los expertos), y afecta desproporcionadamente a jóvenes en riesgo (44%) y comunidades marginadas (33%). **Conclusiones:** Se concluye que esta problemática es un síntoma de profundas fallas institucionales y vulnerabilidades sociales. El estudio destaca una ventana de oportunidad crítica para actuar, siendo imperativa una respuesta integral que combine estrategias de salud pública y un fortalecimiento riguroso de los controles para contener la amenaza y evitar una escalada de la crisis.

Palabras Clave: Fentanilo; tráfico ilícito; uso no médico; sobredosis; desviación de productos farmacéuticos; salud pública; vulnerabilidad social.

RESUMO

Análise histórica e impacto social e na saúde do uso de fentanil na Colômbia

Introdução: O fentanil, um opioide sintético até 100 vezes mais potente que a morfina, desencadeou uma crise global de saúde pública. Na Colômbia, seu crescente desvio do sistema médico para mercados ilícitos representa uma ameaça emergente que exige uma análise aprofundada. **Objetivo:** O objetivo desta pesquisa foi realizar uma análise abrangente do fenômeno do fentanil no país, abordando sua história, o impacto socio-sanitário atual e as falhas sistêmicas que facilitam sua disseminação. **Metodologia:** Foi empregada uma metodologia qualitativa, combinando análise documental narrativa com entrevistas com informantes-chave diretamente envolvidos no controle legal e na resposta institucional ao opioide. **Resultados:** Os resultados revelam que a Colômbia está em uma fase inicial, definida pelo desvio de medicamentos em vez da produção clandestina. Existe uma complexa rede de tráfico, envolvendo atores legais e ilegais, sendo hospitais e clínicas os principais pontos de desvio, segundo 67% dos entrevistados. Esse desvio causa um grave impacto na saúde, incluindo mortes por overdose (relação apontada por 78% dos especialistas), e afeta desproporcionalmente jovens em situação de risco (44%) e comunidades marginalizadas (33%). **Conclusões:** O estudo conclui que esse problema é sintoma de falhas institucionais profundas e vulnerabilidades sociais. Ele destaca uma janela de oportunidade crítica para agir, tornando imperativa uma resposta abrangente que combine estratégias de saúde pública com o fortalecimento rigoroso dos controles para conter a ameaça e evitar a escalada da crise.

Palavras-chave: Fentanil; tráfico ilícito; uso não médico; overdose; desvio de medicamentos; saúde pública; vulnerabilidade social.

1. INTRODUCTION

Fentanyl, a synthetic opioid initially developed as a powerful analgesic for controlled clinical settings, now represents one of modern pharmacology's greatest paradoxes [1-3]. Its extraordinary potency, 50 to 100 times greater than that of morphine, makes it an indispensable therapeutic tool but also places it at the epicenter of a devastating global public health crisis [4-6]. Fueled by its illicit manufacture and distribution, this substance has caused a large-scale health emergency in North America, and its presence is increasingly notable in Latin America [7, 8]. In Colombia, the growing shift of fentanyl from the medical sphere to illegal markets has raised alarm bells, highlighting a worrisome trend where synthetic opioids, often mixed with other drugs, are beginning to displace traditional substances and exponentially multiply the risk of fatal overdoses [9, 10].

Although the fentanyl crisis has been extensively documented in countries like the United States and Mexico, there is a lack of comprehensive, specific analysis of its impact in Colombia [7]. Most reports focus on seizure statistics or general epidemiological alerts [11, 12]. A thorough investigation is needed to connect the drug's historical journey—from its therapeutic origins to its current status as a threat—with the unique characteristics of the Colombian context [10]. There is a need for a study that examines the interconnectedness of institutional failures, socioeconomic vulnerabilities, and local drug trafficking dynamics that are facilitating its spread and use in the country.

The primary objective of this research is to comprehensively analyze the fentanyl phenomenon in Colombia, detailing its historical evolution, its current impact on public health and public safety, and the systemic failures that have allowed it to take root. The goal is to understand the structural factors that promote its diversion and illicit use in order to provide an integrated diagnosis that can serve as a foundation for designing more effective public policies. This study is crucial given the sustained increase in fentanyl-related cases in Colombia, as warned by the Drug Observatory [10]. The complexity of the phenomenon—spanning from pharmacology to criminology and sociology—demands a multidisciplinary approach that moves beyond fragmented perspectives. Understanding the deep-seated causes of its expansion is critical not only for mitigating immediate harm through public health strategies but also for anticipating and preventing a crisis of the magnitude seen in other regions.

The growing fentanyl crisis in Colombia is not an isolated event or a simple extension of traditional drug trafficking; it is the predictable consequence of a set of interconnected systemic failures. It is postulated that the combination of deficient pharmaceutical regulation, drug control strategies focused on interdiction rather than public health, and profound socioeconomic vulnerabilities (such as lack of access to mental health services) creates an environment conducive to the rapid expansion of this synthetic opioid's use [13].

This article traces the journey of fentanyl from its creation in the Janssen laboratories to its current central role in the global public health crisis. Its pharmacology will be analyzed to understand the root of its potency and lethality. Subsequently, the focus will shift to the Colombian landscape, examining how illicit market dynamics and institutional weaknesses have shaped a high-risk scenario. Finally, current responses will be evaluated, and a paradigm shift toward an integrated approach of public health and harm reduction will be proposed as the only effective path to contain this growing threat.

1.1. Historical development of fentanyl

The story of fentanyl begins in the late 1950s at the Janssen Pharmaceutica laboratory in Beerse, Belgium, under the leadership of its founder, Dr. Paul Janssen [14, 15]. A visionary chemist and pharmacologist, Janssen aimed to synthesize an opioid analgesic that would overcome the limitations of morphine, the gold standard of the era (Figure 1) [1]. The objectives were clear: create a molecule with greater potency, a faster onset of action, and, crucially, an improved safety profile, particularly regarding cardiovascular effects. Morphine was known to induce histamine release, which could cause vasodilation and hypotension—undesirable complications during surgical procedures [4, 5].

In 1959, after systematically synthesizing and evaluating a series of compounds, Janssen's team achieved its goal with the creation of fentanyl [16-18]. The new molecule proved to be 50 to 100 times more potent than morphine, with an almost immediate onset when administered intravenously and a shorter duration of action, allowing for more precise control by anesthesiologists [19, 20]. Furthermore, it did not cause significant histamine release, providing the desired hemodynamic stability. Following rigorous clinical trials, fentanyl was introduced into

medical practice in Europe in 1963 and received approval from the U.S. Food and Drug Administration (FDA) in 1968, marketed under the brand name Sublimaze® [21-23]. Its arrival marked a milestone in modern anesthesiology and it quickly became one of the most widely used opioids in operating rooms worldwide [24, 25].

The success of fentanyl in surgery prompted Janssen Pharmaceutica and other companies to explore new delivery methods to expand its therapeutic utility beyond the operating room [26-28]. This innovation led to the development of various formulations designed to manage different types of severe pain [19, 20]. One of the most significant innovations came in the 1990s with the introduction of the fentanyl transdermal patch, marketed as Duragesic® [29, 30]. This delivery system revolutionized the treatment of chronic pain, especially persistent cancer-related pain [31, 32]. The patch, which adheres to the skin, contains a fentanyl reservoir that is released slowly and steadily, absorbing through the skin into the bloodstream over 48 to 72 hours. This provided constant, sustained pain relief, significantly improving patients' quality of life and freeing them from the need for frequent oral analgesics [3, 29, 33].

Subsequently, to address "breakthrough pain"—acute, transient exacerbations of pain in patients with otherwise controlled chronic pain—fast-acting formulations were developed [34]. Among these were transmucosal oral lozenges, such as Actiq®, popularly known as "fentanyl lollipops," which consisted of a fentanyl matrix on an oral applicator [35]. As it dissolved in the mouth, the drug was rapidly absorbed through the oral mucosa, providing almost immediate relief. This was followed by other formulations like buccal tablets (Fentora®), sublingual tablets (Abstral®), and nasal and sublingual sprays, all designed for the same purpose: rapid drug delivery to control peaks of intense pain [36-38].

However, while fentanyl is a promising tool against pain, it has generated one of the most devastating public health crises in history [39]. The fentanyl crisis did not emerge in a vacuum; it is the most recent and lethal phase of an opioid epidemic that has evolved in three distinct, overlapping waves in the United States—a public health catastrophe largely incubated within the healthcare system and the pharmaceutical industry itself [39].

The first wave began in the 1990s, driven by a paradigm shift in pain management and, critically, by the business practices of the pharmaceutical industry. In 1995, Purdue Pharma launched OxyContin, an extended-release formulation of the opioid oxycodone [40]. The company undertook an unprecedented and highly aggressive marketing campaign targeting both doctors and patients, in which the drug's addiction risk was systematically downplayed. The idea was promoted that due to its slow-release mechanism, the potential for abuse was minimal. Sales representatives assured doctors that less than 1% of users would develop an addiction, despite the company's own internal studies from as early as 1999 indicating the true figure could be as high as 13%. This misinformation, coupled with lobbying to treat pain as the "fifth vital sign," led to the massive over-prescription of opioid analgesics for a wide range of conditions, many of which did not warrant such a powerful treatment. By 2012, at the peak of this wave, 259 million opioid prescriptions were issued in the United States—almost one for every person in the country. This practice created a vast population of patients with iatrogenic dependence, an addiction caused by medical treatment [41].

The second wave began around 2010 as a direct consequence of the first. As the scale of the addiction crisis became apparent, health and regulatory authorities began taking steps to restrict opioid prescribing. Stricter guidelines and monitoring systems were implemented, making it harder for many who had already developed a dependency to obtain prescriptions. Without adequate access to treatment for opioid use disorder, a large number of people were forced to seek alternatives on the illegal market. Heroin, being cheaper and more accessible,

became the primary option, leading to a resurgence in its use and a rise in related overdose deaths [42, 43].

The third and most deadly wave began around 2013 with the influx of illicitly manufactured fentanyl (IMF) into the drug market. Traffickers quickly realized the economic advantages of fentanyl: its synthetic production in a lab was cheaper, faster, and more scalable than cultivating poppies for heroin, and its extreme potency allowed for a much larger number of doses to be trafficked in a smaller physical volume. IMF began appearing as an adulterant in the heroin supply, often without the user's knowledge, triggering an unprecedented and exponential spike in overdose deaths. Between late 2013 and 2014, over 700 fentanyl-related deaths were already recorded in the U.S., a figure that would only escalate dramatically in the following years [44].

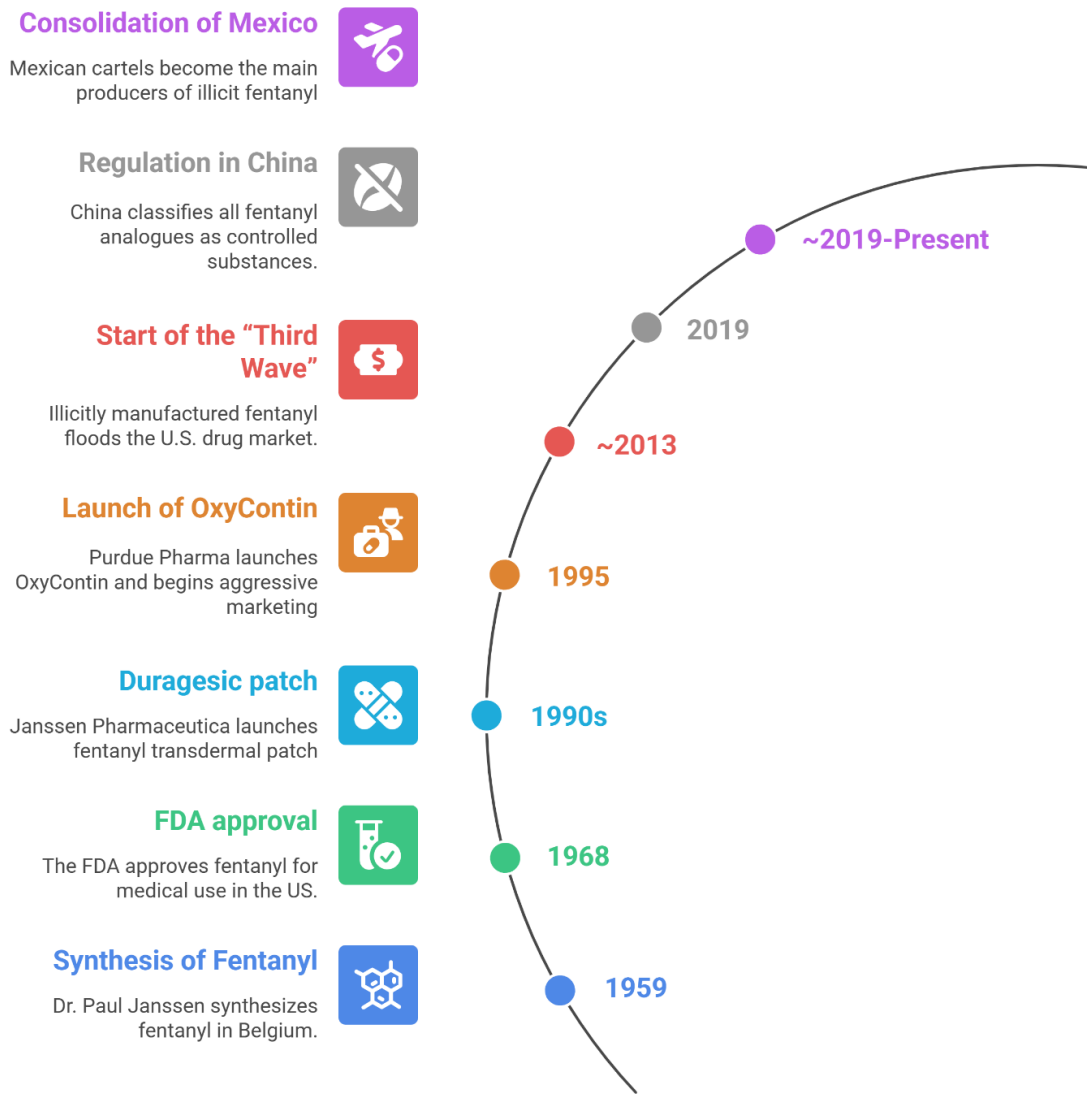

Figure 1. Key milestones in the history of fentanyl.

1.2. Chemistry, synthesis, and licit *vs.* illicit routes

From a chemical perspective, fentanyl (Figure 2), systematically named *N*-(1-(2-phenethyl)-4-piperidinyl-*N*-phenyl-propanamide (Molecular formula: $C_{22}H_{28}N_2O$), belongs to the 4-anilinopiperidine family [1]. Its structure is fundamentally different from natural and semi-syn-

thetic opiates like morphine, codeine, or heroin, which are based on the phenanthrene skeleton. Fentanyl is a fully synthetic compound derived from meperidine, giving it distinct pharmacological properties [45, 46].

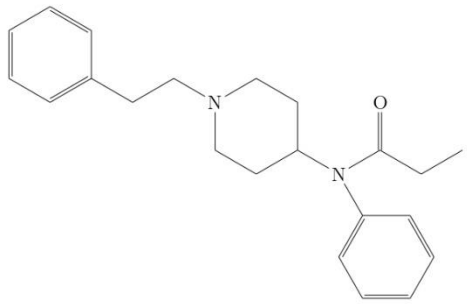

Figure 2. Chemical structure of fentanyl.

The structure of fentanyl has served as a molecular scaffold for developing numerous analogs by selectively modifying parts of the molecule to modulate its potency, onset, and duration of action. In the clinical setting, this has resulted in a family of highly useful opioids [47]:

i). Alfentanil and Sufentanil (Figure 3 and 4): Analogs with an even faster onset and shorter duration, ideal for brief surgical procedures [48, 49].

ii). Remifentanil (Figure 5): A unique analog with an ester linkage that is rapidly hydrolyzed by plasma esterases, giving it an ultra-short half-life (3-5 minutes) and allowing for very precise control of anesthesia without accumulation [50, 51].

iii). Carfentanil (Figure 6): An extremely potent analog, approximately 10,000 times more potent than morphine, whose use is restricted to tranquilizing large animals like elephants. Its appearance on the illicit drug market has caused clusters of mass overdoses due to its incredibly narrow safety margin [52, 53].

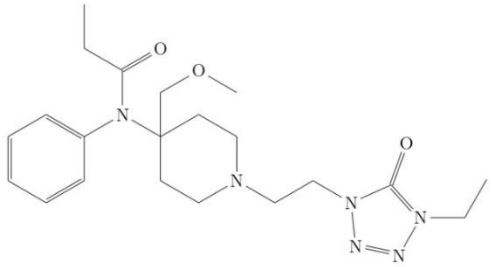

Figure 3. Chemical structure of Alfentanil.

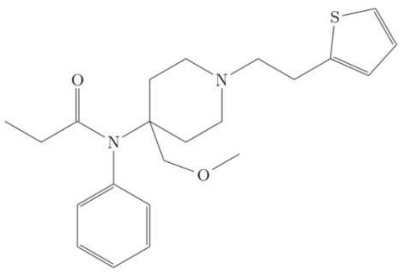

Figure 4. Chemical structure of Sufentanil.

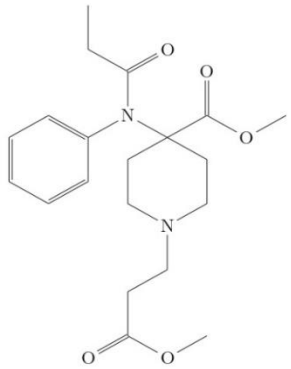

Figure 5. Chemical structure of Remifentanil.

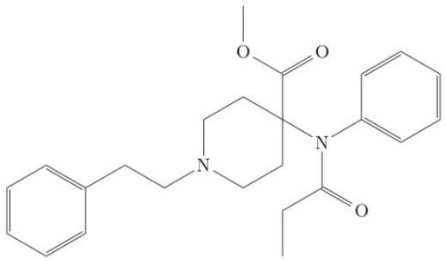

Figure 6. Chemical structure of Carfentanil.

These analogs, along with many others created in clandestine labs and known as "designer drugs," demonstrate the versatility of the fentanyl structure for chemical manipulation [54, 55]. The original synthesis developed by Paul Janssen is an example of elegance in organic chemistry, but its complexity and the reagents it requires make it impractical for large-scale clandestine production. The classic route, described in scientific literature, involves several steps [55, 56]:

i). Condensation of 1-benzyl-4-piperidone with aniline to form a Schiff base.
ii). Reduction of the resulting imine double bond to obtain 1-benzyl-4-anilinopiperidine.
iii). Acylation of this intermediate with propionic anhydride.
iv). Debenzylation of the protecting group on the piperidine nitrogen via catalytic hydrogenation, using a palladium-on-carbon (Pd/C) catalyst. This step produces the key precursor known as norfentanyl.
v). Finally, *N*-alkylation of norfentanyl with a 2-phenethyl halide to yield fentanyl.

Although efficient in a pharmaceutical lab setting, the use of precious metal catalysts like palladium and the need for high-pressure hydrogenation equipment make this route costly and technically demanding, pushing it out of favor with illicit producers.

Unlike pharmaceutical labs, clandestine laboratories have adopted alternative synthesis routes that prioritize simplicity, low cost, and, above all, the use of chemical precursors that, until recently, were not strictly regulated. The two best-known methodologies are the "Siegfried route" and the "Gupta route". The Siegfried route, in particular, has become the most prevalent. This route often begins with a key precursor: N-phenethyl-4-piperidone (NPP) (Figure 7) [57, 58].

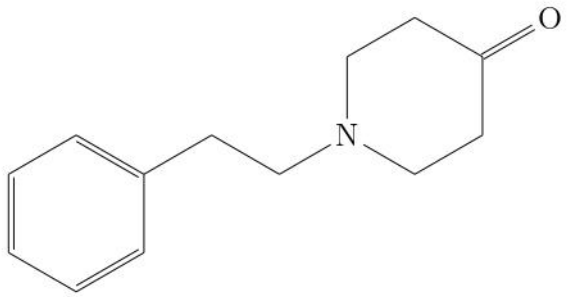

Figure 7. Chemical structure of *N*-phenethyl-4-piperidone.

From NPP, the synthesis can proceed in two main ways [47]:

i). Two-step pathway: First, a condensation of NPP with aniline followed by a reduction (e.g., with sodium borohydride) to form the intermediate 4-anilino-N-phenethylpiperidine (ANPP). Then, the ANPP is acylated with propionyl chloride or propionic anhydride to produce fentanyl.
ii). One-step pathway (reductive amination): NPP reacts directly with aniline in the presence of a reducing agent to form ANPP, which is then acylated as in the previous pathway.

Due to their central role in illicit production, both NPP and ANPP have been subjected to strict international control and are included in Schedule I of the 1988 United Nations Convention [59]. In response, other precursors and intermediates like norfentanyl, 4-anilinopiperidine (4-AP), and 1-boc-4-AP have also been added to control lists in recent years. While controlling precursors is a necessary tool, it has proven to be an inherently reactive strategy with limited effectiveness. Transnational organized crime has demonstrated remarkable chemical agility, consistently outmaneuvering the slow bureaucracy of international regulation in a perpetual

game of "cat and mouse". The process is cyclical and predictable: law enforcement and international bodies identify an essential chemical precursor, like NPP. After a lengthy diplomatic and regulatory process, the substance is finally added to UN control lists, restricting its legal trade. However, chemists working for criminal organizations employ two main strategies to evade these controls. The first is the use of "masked" or "designer" precursors [60, 61].

This technique is based on the organic synthesis concept of "protecting group chemistry". A controlled precursor, like 4-anilinopiperidine (4-AP), is taken, and a "protecting group" is added to a reactive part of the molecule. A common example is the tert-butoxycarbonyl (Boc) group, which is added to the piperidine nitrogen to create 1-boc-4-AP [62]. This new molecule, though chemically very similar, is not (initially) on the list of controlled substances and can be traded with fewer restrictions. For the clandestine producer, removing the "Boc" group is a simple, high-yield reaction step that regenerates the necessary 4-AP precursor to continue the synthesis [62].

The second strategy is to move "upstream" in the synthesis chain. Instead of trying to acquire the controlled precursor (e.g., NPP), clandestine labs acquire basic chemical building blocks—which have widespread industrial use and are virtually impossible to regulate—and synthesize the precursor themselves. This "upstream synthesis" capability gives them extraordinary resilience against precursor control efforts. This adaptability shows that an approach focused solely on regulating a limited number of chemicals is destined for partial and temporary success. The true strength of the criminal system lies in its chemical knowledge and capacity for innovation—a challenge that current policies struggle to counter effectively.

2. METHODOLOGY

2.1. Research design

This research is part of a narrative literature review, a methodological approach that allows for a comprehensive exploration and synthesis of a topic from various perspectives. This approach identifies the topic's historical development, current debates, and emerging areas of research. Then, it connects the topic with information generated by experts. This method was chosen because it is well-suited to integrating knowledge from multiple disciplines, including pharmacology, public health, sociology, and history, to construct a cohesive analysis of the impact of fentanyl in Colombia.

2.1.1. Search strategy and source selection

A systematic and multifaceted search strategy was designed to ensure a comprehensive and relevant review of the literature. The search was conducted between July and September 2025, with no initial publication date restrictions, to include foundational historical documents on the synthesis and development of fentanyl. However, priority was given to works published in the last two decades to analyze its more recent social and health impacts.

The selection of articles was based on an iterative process. Initially, seminal articles and comprehensive reviews were identified. Subsequently, a "snowballing" technique was applied, reviewing the reference lists of key documents to find additional relevant sources.

2.1.2. Databases searched

High-impact global and regional databases were consulted to ensure broad and diverse coverage. The global databases consulted were Scopus, Web of Science (WoS), PubMed/MEDLINE and Google Scholar. The Latin American Databases consulted were: SciELO (Scientific Electronic Library Online), LILACS (Latin American and Caribbean Health Sciences Literature)

and Redalyc (Network of Scientific Journals from Latin America and the Caribbean, Spain, and Portugal).

2.1.3. Search terms

Combinations of search terms were used in both English and Spanish, employing Boolean operators (AND, OR). The keywords included in English were: "Fentanyl", "Fentanyl history", "Fentanyl synthesis", "Opioid crisis", "Synthetic opioids", "Drug policy", "Public health", "Social impact", "Colombia", "Latin America"; and the keywords included in Spanish were: "Fentanilo", "Historia del fentanilo", "Crisis de opioides", "Opioides sintéticos", "Salud pública", "Impacto social", "Política de drogas", and "Colombia".

2.1.4. Inclusion and exclusion criteria

The following criteria were applied for source selection:

2.1.4.1. Inclusion criteria:

i). Articles addressing the history, pharmacology, chemical synthesis, or analogs of fentanyl.
ii). Studies on the social, health, and security impacts of fentanyl and other synthetic opioid use.
iii). Documents on drug policies in Colombia and Latin America.
iv). Official reports from governmental and non-governmental organizations (e.g., Ministry of Justice and Law of Colombia, INCB).
v). Articles in English and Spanish.

2.1.4.1. Exclusion criteria:

i). Articles with a purely clinical focus (e.g., specific anesthesia protocols) that did not discuss the broader context of fentanyl use.
ii). Studies with a strictly veterinary focus.
iii). Editorials, letters to the editor, or conference abstracts without substantial data.

2.1.5. Information synthesis

After selection, relevant information was extracted from each of the 64 documents included in this review. The information was organized and synthesized narratively, grouped into the following thematic categories to structure the article: 1) The history and pharmaceutical development of fentanyl and its analogs; 2) The transition from medical to illicit use and the global public health crisis; and 3) The current landscape of fentanyl in Colombia, including its social and health impacts and institutional responses. This approach allows for connecting historical and scientific evidence with the specific social and political context of Colombia.

Furthermore, a qualitative approach with an exploratory and descriptive scope complemented this study. This design was considered the most suitable for addressing an emerging and complex phenomenon, allowing for a deep dive into the social, health, and institutional dimensions of fentanyl use in the country. The qualitative perspective facilitated the analysis of perceptions, experiences, and narratives of key actors, as well as the interpretation of the regulatory and institutional context surrounding the issue.

2.2. Phases of the research process

The study was structured in four sequential and complementary phases to ensure rigor and systematicity, as described in Table 1.

Table 1. Phases of the research process.

Phases	Description	Objective
Phase I	Semi-structured interviews with key informants.	Obtain primary data on the experiences, practices, and perceptions of professionals with direct involvement in the control and management of fentanyl.
Phase II	Documentary review and analysis (official reports, statistics, scientific literature, and regulatory frameworks).	Contextualize, triangulate, and validate qualitative findings with robust secondary sources.
Phase III	Thematic content analysis of interviews and documents.	Identify recurring patterns, emerging categories, and significant relationships within the data corpus.
Phase IV	Synthesis and integrative interpretation of findings.	Formulate evidence-based conclusions and recommendations for public policy and prevention

2.2.1. Unit of analysis and participant selection

The unit of analysis consisted of key informants, defined as professionals and officials with direct involvement in the legal control, oversight, and institutional response to fentanyl in Colombia. A non-probabilistic purposive sampling method was used, selecting individuals who, due to their role and experience, possessed specialized knowledge and a privileged perspective on the phenomenon.

A total of ten (10) interviews were conducted. This number, though small, is justified by the highly specialized nature of the topic. The objective was not statistical representativeness but rather informational saturation and conceptual depth. Given that the circle of experts with direct responsibility for regulating and controlling fentanyl at the national level is limited, priority was given to the quality and richness of the information this select group could provide. The strategy sought depth over breadth, enabling a dense and detailed dialogue that would not be achievable with a larger but less specialized sample. Exclusion criteria were the absence of a direct professional link to the topic and an unwillingness to participate under the terms of informed consent.

2.3. Data collection techniques and instruments

The main data collection techniques were:

1. Semi-Structured Interview: An open-ended question guide was designed to direct the conversation while allowing the flexibility to explore emerging themes. This instrument was validated by expert review (a qualitative research specialist and a professional from the pharmaceutical sector) to ensure its relevance and clarity.
2. Documentary Analysis: A series of documents were collected and analyzed, including reports from the Colombian Drug Observatory, resolutions from the Ministry of Health and Social Protection, and peer-reviewed scientific literature.

The combination of these techniques (source triangulation) allowed for the cross-referencing and complementing of information, thereby strengthening the validity and reliability of the study's findings.

2.4. Data analysis strategy

The collected information was processed through thematic content analysis. The procedure was conducted manually, beginning with the literal transcription of the interviews. Subse-

quently, an open coding process was applied to identify units of meaning and relevant concepts. These codes were grouped into emerging thematic categories, which allowed for the identification of recurring discourses, institutional tensions, and significant patterns in the data. This interpretive approach facilitated a deep understanding of the participants' narratives.

2.5. Ethical considerations

The research adhered strictly to the ethical principles of research involving human subjects. Written informed consent was obtained from all participants before each interview, ensuring their understanding of the study's objectives and their voluntary participation. The confidentiality and anonymity of the informants were guaranteed by assigning alphanumeric codes to unlink their identities from their testimonies. The project and its instruments were submitted for review to ensure compliance with ethical and methodological standards.

3. RESULTS

The findings of this study, based on interviews with key actors, expose recurring patterns in fentanyl use that reveal profound social and health complexities. These patterns underscore the critical challenges Colombia faces in both public health and security.

The fentanyl phenomenon in Colombia presents a distinctive case study, with a nature that differs significantly from the crises observed in Mexico and the United States. The Colombian situation is in an early stage, characterized not by clandestine production but predominantly by the diversion of pharmaceutical products. This context offers a crucial window of opportunity for implementing preventive intervention and containment strategies.

Field findings from interviews with key informants reveal a sophisticated trafficking network involving both actors from the legal circuit and criminal organizations. The analysis of the identified actors shows the following distribution:

i). 44% are pharmaceutical importers and distributors, indicating a critical vulnerability in the legal supply chain.

ii). 44% is composed of micro-trafficking networks, the National Narcotics Fund, and some clinics, showing the permeability between the health system and illicit markets.

iii). 11% is attributed to illegal groups specializing in the diversion of medicines.

This configuration highlights the structural weaknesses of the Colombian health system in the face of drug trafficking. The fact that 67% of interviewees indicate that fentanyl is primarily diverted from hospitals and clinics confirms that the epicenter of the problem lies in failures of control, monitoring, and possible corruption within the health institutions themselves.

The pharmaceutical diversion thesis is corroborated by the nature of the seizures. Unlike in North America, where clandestinely produced powder and pills predominate, the overwhelming majority of seizures in Colombia are vials of injectable solution. Authorities have confirmed that, to date, no fentanyl synthesis labs have been detected in the country. The volume of these seizures shows an alarming upward trend. While reports in 2018 and 2019 were of quantities smaller than 10 vials, since 2023 significant seizures have been recorded, such as 233 vials in Bogotá, 455 in Cartagena, and 2,000 in Maicao in February 2024 [10].

Regarding mortality, although the figures are low, the trend is also concerning. Between 2013 and 2023, 30 fentanyl-associated deaths were reported, but more than half of them (16 cases) occurred between 2021 and 2023, indicating a clear acceleration of the problem. Further-

more, the mixing with other drugs such as heroin, cocaine, and primarily ketamine was detected in one-third of fatal cases and mentioned by 11% of interviewees as a practice that considerably increases the risk of lethal overdose.

In response to this emerging threat, authorities have begun to mobilize:

i). **Health surveillance:** INVIMA has issued health alerts about fraudulent batches, while the National Institute of Health (INS) maintains surveillance of poisonings through the SIVIGILA system.

ii). **Security strategy:** In 2023, the National Police presented the "Anticipate to Prevent" plan, a comprehensive approach that ranges from prevention and harm reduction to interinstitutional cooperation.

iii). **Legislative reforms:** Bills have been introduced (PL 194 and PL 227 of 2023, [63]) that seek to classify fentanyl trafficking as a standalone crime with significantly higher penalties, in line with its lethality.

The current problem, centered on diversion from the health system, presents a critical opportunity to act. Future success will depend on the state's ability to rigorously strengthen controls over the pharmaceutical supply chain while simultaneously expanding public health strategies, such as risk education and overdose management training. The risk of escalation is imminent; the country's criminal networks could venture into large-scale synthesis or importation if they identify a profitable market. The actions taken today will determine whether Colombia manages to contain this crisis in its current phase or moves toward a public health scenario of the magnitude seen in North America (Figure 8).

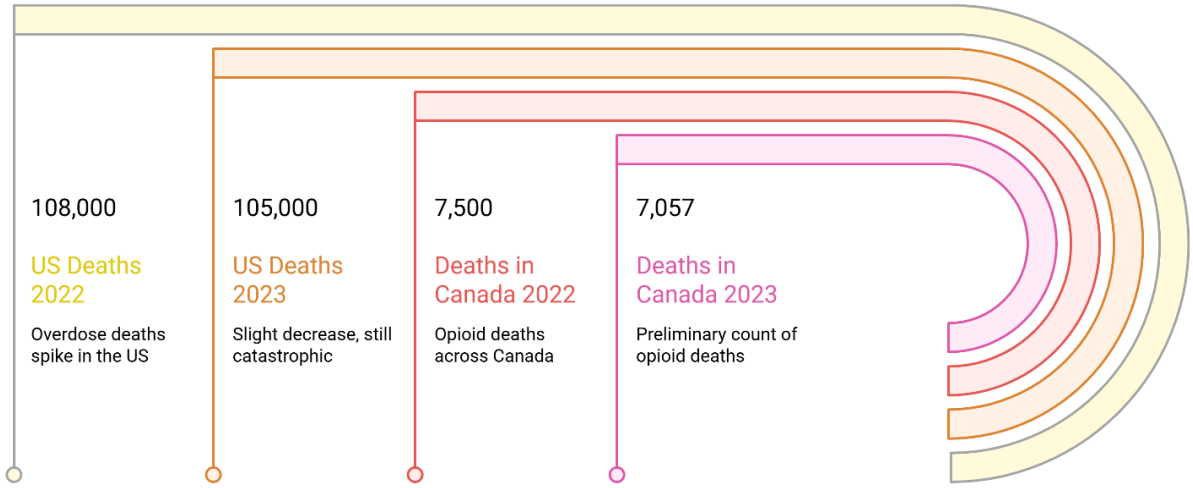

Figure 8. Opioid-related deaths in North America.

3.1. Analysis of the socio-health impact and systemic repercussions of fentanyl use

Fentanyl use generates profound and multifaceted consequences that transcend mortality statistics, permeating the social fabric and overburdening public institutions (Figure 9). The perception of its severity is nearly unanimous: 78% of the experts interviewed state that the primary health impact is the increased prevalence of deaths by overdose. However, this direct effect is merely the epicenter of a crisis with much broader systemic repercussions.

The impact extends to the core of society, where 33% of participants associate opioid use with serious social problems such as family disintegration and rising crime. This disintegration materializes as an increase in children entering the foster care system and a significant loss of economic productivity due to disability and premature death in the working-age population. At the community level, the phenomenon generates collective trauma, fosters stigma,

and erodes social cohesion, which worsens the perception of insecurity and degrades the quality of life, as noted by Vega-Pulido and Estrella (2013) regarding violence associated with drug trafficking [64].

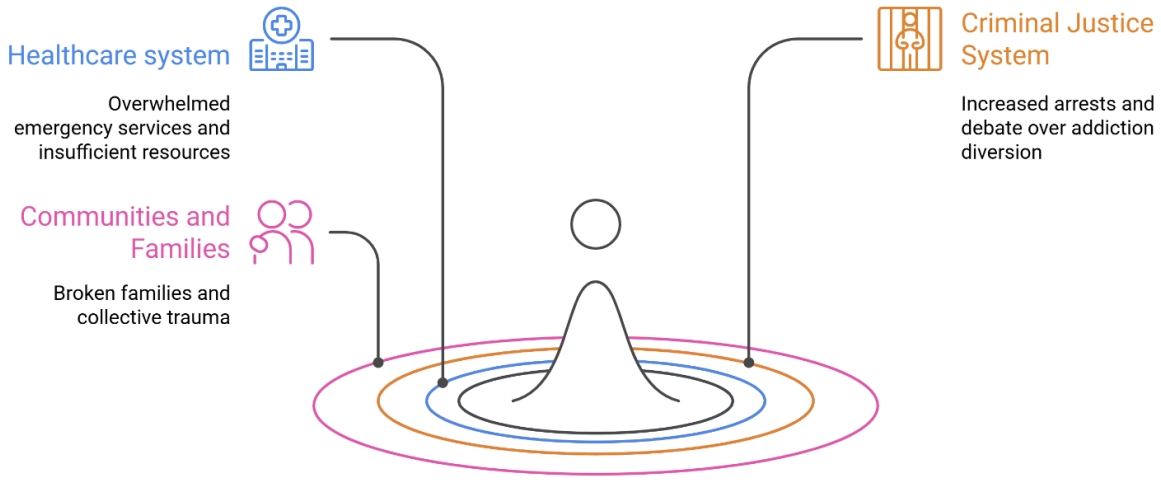

Figure 9. Consequences of the fentanyl crisis.

This crisis places an unsustainable strain on public systems. The healthcare system is overwhelmed, with emergency services and intensive care units saturated by the treatment of acute overdoses and their long-term complications, such as anoxic brain injury. Simultaneously, addiction treatment and mental health centers operate with insufficient resources for a demand that outstrips their capacity. Meanwhile, the criminal justice system faces an increase in drug-related arrests, perpetuating a cycle of criminalizing addiction that sparks debate about the need to shift from a punitive approach to a public health one.

Vulnerability to these impacts is not uniform. The data reveal that the most affected groups are at-risk youth (identified by 44% of interviewees) and marginalized communities (33%). Structural inequality, lack of opportunities, and institutional weakness act as predisposing factors, turning substance use into an escape from precarious living conditions.

Faced with this complex landscape, experts propose a multi-sectoral preventive approach. A majority (56%) consider educational campaigns to be the priority strategy. However, the need for a comprehensive approach is recognized, complemented by strict monitoring in pharmacies (22%) and specialized training in public health (22%). These findings reaffirm the imperative to articulate a state response that integrates public education with the strengthening of institutional controls and international cooperation, in order to mitigate the expansion of use, especially among the most vulnerable populations.

4. DISCUSSION

While a global phenomenon, the fentanyl crisis acquires particularly complex contours in Colombia that demand an analysis beyond traditional criminology. From a psychosocial perspective, the problem is not simply a new substance on the illicit market, but a symptom of deep-seated institutional flaws and pre-existing social vulnerabilities. The findings of this research unveil a perverse dynamic where the infrastructure designed to heal—the healthcare system—becomes a key vector of the crisis. The results are interpreted below through this lens.

The research shows that the fentanyl trafficking network is a hybrid structure, where the porosity between the legal and illegal is the norm, not the exception. The involvement of actors from the pharmaceutical sector and clinics, alongside criminal networks, cannot be seen as a

set of isolated failures. Sociologically, this points to a structural weakness in the state's mechanisms of control and traceability. Phenomena such as corruption and the lack of rigorous oversight, cited by Albores-García and Cruz (2023), are the catalysts that allow a controlled medication to be massively diverted to the black market [65]. This "institutional leakage" is the first link in a chain that ends in a severe public health crisis.

This systemic failure is aggravated by the methods of trafficking. The diversion from hospitals and the subsequent mixing of fentanyl with other drugs like heroin or cocaine is a practice that maximizes both the trafficker's profits and the user's risk of death. This adulteration, documented internationally by authors such as Misailidi *et al.* (2017) [66], creates an extremely high-risk scenario where the consumer has no real knowledge of the potency of the dose they are taking, which exponentially multiplies the probability of a fatal overdose. For health authorities, this represents a major challenge, as they must combat the distribution not just of one substance, but of an unpredictable and lethal cocktail.

The repercussions of this dynamic transcend mortality statistics. While the health impact is devastating—with rising deaths and an overburdened healthcare system—the psychosocial impact is perhaps more profound and lasting. Family disintegration, increased crime, and the erosion of community trust are wounds in the social fabric that take generations to heal. The fentanyl crisis, therefore, should not be framed solely as a health problem, but as an accelerator of social fracture. This reinforces the need for a comprehensive response that, as suggested by Piedrahíta-Bustamante (2014) [67], effectively articulates the public health, criminal justice, and social welfare systems.

Finally, it is crucial to understand who the primary victims of this institutional and social collapse are. Our findings are clear: at-risk youth and marginalized communities bear the heaviest burden of the crisis. From a sociological perspective, their consumption cannot be reduced to an individual choice; it is conditioned by structural determinants such as exclusion, lack of opportunities, and poor access to basic health and education services. In these contexts, fentanyl can emerge as a tragic form of self-medication against the pain of hopelessness. Therefore, any effective prevention strategy must go beyond informational campaigns. It is imperative, as argued by López-Villegas and Sánchez-Sandoval (2024) [68], to implement community intervention and empowerment programs directly in these environments, addressing the root causes of vulnerability and not just its symptoms.

5. CONCLUSIONS

The fentanyl phenomenon in Colombia presents a distinctive nature and is in an incipient phase, defined primarily by the diversion of pharmaceutical products from the legal supply chain rather than by large-scale clandestine production. This central finding reveals that the crisis is not merely a drug trafficking problem but a symptom of deep-seated institutional fissures and pre-existing social vulnerabilities. The porosity between legal and illegal actors, coupled with structural failures in the health system's control and traceability mechanisms, has created an environment where the healthcare infrastructure becomes an unintentional vector of the problem. The consequences of this dynamic are devastating, manifesting as a severe health impact due to the high risk of fatal overdoses, exacerbated by mixing with other substances, and as a profound fracture of the social fabric. This impact disproportionately affects vulnerable populations, such as at-risk youth and marginalized communities, whose consumption is conditioned by structural determinants like exclusion and lack of opportunity. Finally, a paradigm shift in drug policy is imperative, moving toward a comprehensive and multi-sectoral response. This strategy must urgently articulate, *i)* the rigorous strengthening

of controls on the pharmaceutical supply chain to prevent diversion; *ii)* the expansion of public health and harm reduction policies; and *iii)* the implementation of prevention programs focused on the structural causes of vulnerability. Containing the threat in its current phase is crucial to prevent an escalation into a public health crisis of the magnitude observed in other regions.

CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest.

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