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Seizing Shadows: A Data-Driven Exploration of Fentanyl Control in Mexico

A Research Paper Design

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Chapter 1. Introduction & Background

1.1 Introduction

The fentanyl crisis has become one of the most pressing transnational challenges of the 21st century. In Mexico, it exposes a persistent puzzle: although the country is at the center of the global debate on fentanyl trafficking, reliable data on the phenomenon remains fragmented, inconsistent, or politically contested. The tension lies between the opacity between what the state claims to control and what can actually be measured (official and un-official statistics). This research paper seeks to analyse and propose how those fragments of information can be systematically organized to make the dynamics of fentanyl trafficking empirically visible.

For clarity, fentanyl is referred to two fold: basically as the synthetic opioid itself and secondly as the broader chemical economy that sustains its production through precursor substances (legal industrial inputs that can be diverted for illicit manufacture). The concept of fragmentary data includes public records that are incomplete, dispersed across agencies, or produced under conflict political pressures. Together, these concepts capture the empirical problem of studying illicit economies in contexts where the state is both a producer and a gatekeeper of information.

This research also takes place in a broader political context: during the López Obrador administration (2018-2024), tensions with Mexico's transparency institution (INAI) led to budget cuts, legal challenges and a policy arena in itself undermining their role under the claims of inefficiency and corruption. These dynamics weakened the country's information access system, which now has an effect on the access to information in sensitive topics like fentanyl manufacturing. Therefore, the fragmentation of state data explored in this research paper must be understood not only as technical or bureaucratic but as deeply political.

The research paper addresses a key gap in literature: while much research available on the subject focuses on the social or geopolitical consequences of fentanyl, few studies have examined how data scarcity and institutional fragmentation shape the very quantification of the problem. Therefore, this work contributes by filling the gap providing a methodological perspective, showing not only what can be known about fentanyl flows, but how knowledge is constructed under conditions of limited transparency.

The research builds on a theoretical framework informed by data assemblage theory and critical governance studies (Latour, 2010; Poorthuis, 2021). These perspectives view data not as neutral

facts but as products of institutional, technical, and political processes. By treating datasets as social artefacts, the research paper explores how state's practices of measurement and omission define what becomes "visible" about illicit economies.

To address this, the research paper constructs and integrates two original datasets: one on fentanyl seizures (2018-2025) and another on precursor imports (2021-2025). The analysis combines descriptive statistics, scenario modeling, and methodological reflection. The chapters follow a logic of first introducing the research problem and literature, secondly the outlines of the theoretical and methodological framework, then present the empirical analysis and the potential discussion and limitations of the findings, with a proposal on how to solvent them for further researches on this difficult and new topic at the moment.

Ultimately, this research paper argues that fragmentary and politically contested data can still be transformed into structured, meaningful knowledge, and that doing so provides both an analytical and political contribution to understanding how Mexico measures and governs its fentanyl economy.

1.2 The Geopolitical Relationship Between the United States of America (U.S.) and Mexico

The U.S., one of the biggest economies on the planet, is a very important commercial partner for Mexico. The U.S. is even more relevant to Mexico than China and Canada (Secretaría de Economía, 2024). In 2024, this commercial relationship meant $200,014 billion dollars, 15.8% of the U.S. economy (Secretaría de Economía, 2024), with trade based on mechanical, electrical and agrarian goods sectors. This important commercial relationship has also led to opportunities for criminal groups in Mexico to smuggle illegal opioids into the U.S. blent in with legal products that are normal within this commercial relationship.

The U.S.-Mexico relationship is characterized by what scholars describe as "asymmetric interdependence" (Keohane & Nye, 1977): both economies rely on one another, but the United States exercises its leverage over the relationship through market access, investments, and coercive diplomacy. Mexico on the other hand, while dependent on trade, retains control over the physical territory that enables or constrains transnational flows (goods, people, and illicit substances). As Andreas (2022) observes, the border has become both a site of economic integration and of securitized anxiety, where cooperation and confrontation co-exist. Fentanyl

trafficking epitomizes this duality: a product of globalization and trade openness, that simultaneously fuels new security dilemmas.

In recent years, one of the main social concerns in the U.S. has been substance abuse and more specifically the dramatic opioid consumption raise. Several scholars have divided this crisis into three stages (Moore, Olney and Hansen, 2024), where Mexico plays a key role in all. The first consumption crisis took place in the 1980s following an alliance between the Colombian cartels and the first Mexican cartel groups that started producing and moving marihuana, cocaine and methamphetamines mostly regionally. Before, Colombia had a so-called monopoly of the illegal market. The U.S. reinforced in the surveillance of Florida to control cocaine imports from Colombia and as a result they actually faced an important decrease (Andreas, 2022).

In this context, Mexican cartels saw a profitable business in just smuggling the opioids from Colombia to the U.S. with small aircrafts and ground-level operations. According to State Department estimates, "by 1989 nearly a third of cocaine exports were routed through Mexican territory; by 1992, more than half; later in the 1990s, as much as 75–80 percent" (Andreas, 2022). For Mexico, this was a crucial moment for the consolidation of criminal groups and the start of a fragmentation of these cartels into smaller cells that led to a more complex and entangled insertion of violence and crime in the country (Astorga, 2021).

In the second phase, the introduction of heroin and the deathly effect it potentially has in overdose completely changed the way this crisis was seen as a public policy matter. The amount of deaths between 2010 and 2015 (around 44,000) related to substances meant a quadruple increase as compared to previous years (Moore, Olney and Hansen, 2024). Then, in the third stage, fentanyl was introduced as a heroin substitute because it is cheaper and 50 times more potent (Pardo *et al.*, 2019). Between 2012 and 2022 fentanyl was responsible for 90% of the drug-related deaths in the U.S., around 350,000 in that period (Moore, Olney and Hansen, 2024). Fentanyl is deadly with a dose of only 2 grams (Ferragamo and Klobucista, 2025) making it a synthetic opioid that threatens public health as it is easier to sell, requires a smaller dose to be lethal and is very addictive.

The transformation from natural to synthetic opioids marked a qualitative shift in the global drug economy. Unlike heroin or cocaine, whose production depends on agricultural cycles and large-scale smuggling, fentanyl's synthesis relies on industrial precursors and chemical knowledge. This transition has blurred the boundaries between legal and illegal markets, as many of the substances used in fentanyl production such as N-Phenethyl-4-piperidone (NPP) or

4-anilo-N-phenethylpiperidine (ANPP) are legitimate inputs in pharmaceutical and chemical industries. As a result, enforcement has moved from rural production in the desert, to monitoring of international supply chains, creating new data and government challenges

1.3 Fentanyl

Fentanyl was created in 1960 by Paul Janssen, a Belgian chemist, Janssen pretended to create an analgesic that could be stronger than morphine for surgery purposes and for new pain syndromes that were emerging at the time (Stanley, 2014). Fentanyl turned out to be 25 times more potent than morphine and in 1963 it was used as an intravenous analgesic in Europe and in 1968 it was introduced in the U.S. (Stanley, 2014).

The chemical structure of Fentanyl consists of 4 elemental components: a piperidine ring, an aniline ring, an alkyl chain and an acyl group (Chung, Gottesdiener and Jorgic, 2024). From the perspective of a social science paper, the relevant information of these chemical components is that they're available in products of other industries (perfumes, pesticides and plastics) making fentanyl an opioid easy to produce and even harder to track.

Although it is not new, for more than 35 years fentanyl did not have a breakthrough as an synthetic opioid until the late 1990s in the U.S., when the Chinese chemical industry started developing variations of fentanyl that started being distributed as unprescribed pain-killers in pharmacies (Pardo *et al.*, 2019). Fentanyl kills because it works through the respiratory system and when it is overdosed, constrains the lungs causing the user to potentially suffocate (Stanley, 2014).

Unlike other opioids, the fentanyl structure allows "cooks" to play around with the ingredients to make it even harder to track the precursor chemicals used for production. The method used to cook fentanyl is called "The Gupta Method" after Indian scientist Pradeep Kumar Gupta and requires only 3 steps, cooking in room-temperature and no special lab equipment, making it as simple as "cooking chicken soup" (Chung, Gottesdiener and Jorgic, 2024).

Having an easy cooking method and accessible ingredients have generated different variations of fentanyl with different effects and ingredients. An example of this is Carfentanil, that has a tweaked chemical, creating a substance 100 times more potent than fentanyl and usually used to sedate elephants (Chung, Gottesdiener and Jorgic, 2024)

Nowadays, fentanyl can be synthesized with low-quality gear and ingredients that are distributed legally in the pharmaceutical industry, causing an exponential increase in production from various countries. The first seizures of fentanyl in the U.S. were from China and Mexico, but "there have been reports of seizures of fentanyl in products from countries like India, Belgium, Canada, Estonia, Taiwan, The Dominican Republic and Fiji" (Australian Federal Police, 2022).

According to interviews with Mexican cartel fentanyl cooks, on average, every dollar invested in producing fentanyl can lead to profit which is 800 times sales (Chung, Gottesdiener and Jorgic, 2024), essentially because a kilo of Fentanyl powder is enough for 500,000 pills (Chung, Gottesdiener and Jorgic, 2024), making it one of the most profitable and low-risk businesses in the planet currently.

1.4 Fentanyl Production in Mexico.

Mexican drug cartels are adaptable organizations. In the fentanyl context an opportunity to modify the business scheme from the big marihuana and opioid fields in the rural areas of the country that are visible for the army's helicopters and drones to small laboratories with very limited equipment which may be equipped and dismantled in a short period of time (Krever, 2025).

The main producer of fentanyl in Mexico is the Sinaloa Cartel. The cartel controls the northern border region (Krever, 2025). This group has set a region named "the golden triangle" consisting of a desert region between the states of Chihuahua, Sinaloa and Durango (Pérez Ricaert and Ibarrola García, 2023). In this region access is very difficult or nearly impossible and has been the default zone for drug production since the 1940's (Pérez Ricaert and Ibarrola García, 2023). Now with Fentanyl the production labour is even easier than before, making seizures and laboratories searching a very difficult task for the government. Therefore, fentanyl is produced and exported to the US without the need to move it inside Mexican territory (Krever, 2025), this could be a potential explanation of how Mexico started being an important fentanyl producer without creating a consumption crisis within the country.

A BBC interview of a drug cartel member involved in fentanyl production (Krever, 2025) established that the seizures and coordination between the national government with other agents is diminishing production levels and the cartel member interviewed stated that "business is not that good these days" (Krever, 2025). Nevertheless, at the same time violence in the border region has increased due to territorial disputes between the Sinaloa Cartel and other

groups for control over the border. Culiacán, the capital of the state of Sinaloa has seen the killing of 1200 people in the last year (Krever, 2025).

These production dynamics also reveal the blurred lines between industrial and criminal economies. The laboratories depend on legally traded precursors (mostly imported from China or the U.S.). Therefore, it is extremely difficult to differentiate between the illicit markets with the legitimate trade networks when it comes to fentanyl. This interconnection challenges conventional enforcement paradigms and even methodological approaches to calculate the size of this shadow economy, bringing a need for a new integrated data approach that follows both legal and illegal supply chains. Understanding how the data is produced, manipulated, and politicized becomes central to any assessment of Mexico's role in the U.S. opioid crisis. This argument provides the foundation for the following sections on U.S. policy and the construction of fentanyl as a policy arena.

1.5 U.S. Anti-Fentanyl Policy in the Southwest Border.

Since the Biden administration (2021-2025) the fentanyl consumption crisis has been diagnosed as a problem that comes from other countries and requires cooperation from other countries with the U.S.. Therefore, Biden held several meetings with his homologue in Mexico, Andrés Manuel López Obrador (2018-2024). Even though a collaborative spirit was always expressed by the Mexican president, the White House felt that the drug policy that was carried in Mexico against production and smuggling was "inefficient" and an overall failure (CFR.org editors, 2025).

As a consequence, since the last years of the Biden administration, the US has had a program consisting of secret drone flights searching for fentanyl labs on Mexican territory, with the aim of informing the Mexican government so that it can conduct smarter seizures and arrests with this information (Barnes *et al.*, 2025). After Donald Trump assumed office in January 2025, the CIA has claimed that the drone flights have continued and even though the information has been shared with the Mexican government, the office reports that "only a couple arrests have been made after the sharing and that the coordination is very slow". (E. Barnes *et al.*, 2025)

Furthermore, the Trump administration in early March of 2025 decided to shift the opioid policy with a commercial approach, declaring that they will implement commercial sanctions (tariffs) to products coming from countries that produce fentanyl (Staff, 2025). The White House declared

in a report of the main enemies of the U.S. government that the main threat labelled as foreign terrorists are the Mexican cartels that export fentanyl.

This is because the U.S. claims that China was the main producer of fentanyl and after China claimed that they have regulated fentanyl production and distribution, the synthetic ingredients that constitute fentanyl continue their production as it is China's national interest to continue developing their chemical industry. Now the White House argues that China exports the ingredients for fentanyl to Mexico, making drug cartels in Mexico the main source for this substance entering U.S. territory (Staff, 2025).

1.6 The Policy Arena of Fentanyl

The fentanyl crisis is not only a public health emergency (opioid crisis in the U.S.), but also a policy arena where multiple actors: governments, cartels, international agencies, and media outlets negotiate competing narratives and strategies. In this arena, fentanyl functions not merely as a drug but as a "commodity of politics": a material substance whose flows are mobilized as evidence in diplomatic negotiations, trade disputes, and domestic security agendas. Understanding fentanyl as a part of a policy arena requires situating it at the intersection of bilateral politics, international security discourses, and the construction of narratives of blame.

From the perspective of policy analysis, commodities like oil, water or food often structure political conflicts by linking material scarcity to state interests. Fentanyl, even though illicit, functions similarly; its seizures, precursor imports, and overdose figures are strategically deployed as evidence by different governments to reinforce particular narratives. As it has been demonstrated through this chapter, in the U.S. seizures are used to demonstrate "toughness" on border enforcement, while overdose deaths within the country are mobilized to justify exceptional measures, including trade sanctions and drone surveillance over Mexican territory. In Mexico, the same seizures are framed as proof of cooperation and sovereignty, depending on the political context.

As a commodity of politics, fentanyl has symbolic value beyond its pharmacological potency. It becomes a bargaining chip in a wider negotiation over trade, sovereignty, and security. This framing explains why debates about measurement are so politically charged: numbers of seizures or precursor imports are not neutral statistics, but rather contested symbols of responsibility and legitimacy.

1.7 Shifting U.S. Narratives of Blame

The U.S. has consistently externalized the opioid crisis to foreign suppliers. In the early 2000s, China was depicted as the main source of precursor chemicals due to its vast chemical industry and lax tax regulation. When Beijing imposed stricter controls of fentanyl analogues in 2019, attention shifted to Mexico, whose cartels were accused of importing Chinese precursors and producing fentanyl at scale (Felbab-Brown, 2020). By the early 2020s, the official narrative in the White House increasingly portrayed Mexican cartels as "foreign terrorist organizations" responsible for poisoning U.S. citizens, therefore justifying more coercive measures (Walsh, Brewer & Isacson, 2024).

This discursive shift is not merely rhetorical. It reflects a political strategy of blame-shifting. By locating the crisis abroad, U.S. officials avoid confronting domestic drivers: the over-prescription of opioids by U.S. pharmaceutical companies, regulatory failures, and structural addiction vulnerabilities. Scholars like Carpenter (2022) argue that such externalization distorts policy priorities, reinforcing a securitized "war on drugs" logic rather than a public health approach.

The blame narrative has a strong relation with opportunism. When U.S.-China relations deteriorated, China was again labeled as the source of precursors "enabling" Mexican cartels. Under Trump's second administration, this narrative became even more strategic, linking fentanyl to broader commercial disputes and justifying tariffs on Mexican products (Staff, 2025). Fentanyl thus became entangled in trade wars, serving as both a moral panic and a policy instrument in U.S. foreign relations.

1.8 Mexico's Dilemmas: Between Resistance and Cooperation

Mexico faces a dilemma on its part. As the main trading partner of the U.S., it cannot afford open confrontation, yet it also resists being reduced to a mere enforcer of U.S. drug policy.

Under Andrés Manuel Lopez Obrador administration (2018-2024), the "hugs not bullets" strategy aimed to reduce violence across the country by attacking the root causes diagnosed as structural inequalities. This approach pursued an emphasis on social causes, but in Washington it was perceived as ineffective, even negligent (Krever, 2025). His successor, Claudia Sheinbaum (2024-2030) has adopted a more pragmatic dual approach even though she shares the same political platform as Lopez Obrador. This approach consists in both rhetorically resisting U.S. securitization ("collaboration, not subordination"), while simultaneously increasing troop

deployments, seizures, and enforcement measures to avoid punitive trade measures. This reflects what Benitez Manaut (2023) calls the "sovereignty paradox": Mexico must assert autonomy while visibly cooperating to maintain trade privileges.

The tension is most evident in the issue of tariffs. By linking fentanyl to commercial sanctions, the U.S. transforms drug enforcement into an economic negotiation. Mexico responds by showcasing rising numbers of seizures and arrests, not only as security measures but also as bargaining evidence in trade diplomacy. The policy arena binds together seemingly unrelated domains: public health, security, and commerce into a single field of negotiation.

1.9 Securitization and the Framing of Fentanyl

The fentanyl crisis illustrates processes of securitization (Buzan, Waever & de Wilde, 1998), whereby an issue is reframed as an existential threat to justify extraordinary measures. Overdose deaths in the U.S., framed as an urgent national security problem, have been used to rationalize drone flights over Mexican territory (Barnes et al., 2025), proposals to deploy U.S. military forces across the border, and the designation of Mexican cartels as terrorist organisations.

This securitization has two consequences. First, it legitimizes extraordinary interventions that in other contexts would be politically unthinkable. Second, it reconfigures the relationship between Mexico and the U.S. by subordinating drug policy to the rationality of national security, marginalizing public health approaches. The securitization lens allows us to explain why data on seizures or imports, even though they're imperfect, obtains outsized political importance: they are mobilized as "proof" that extraordinary measures are necessary.

The U.S.- and Mexico's relationship on the fentanyl crisis also reflects dynamics on asymmetric interdependence (Keoane & Nye, 1977). While the U.S. wields greater power through tariffs, surveillance, and diplomatic pressure, it also depends on Mexico's territorial cooperation to implement enforcement. On the other hand, Mexico is structurally dependent on access to U.S. markets but retains leverage by controlling the physical routes of smuggling. This asymmetry creates a mutual vulnerability that shapes the policy arena.

1.10 Measurement in the Policy Arena.

Given this context of politicisation and securitization, the act of measuring fentanyl flows is itself political. Statistics on seizures, precursor imports, and overdose deaths are mobilized not only as

indicators of policy success but as weapons in bilateral negotiations. As Andreas (2022) notes in the context of border enforcement, numbers are central to the "politics of performance", where governments demonstrate action through measurable outcomes, regardless of their real impact on flows.

This underscores the importance of this research paper: developing a transparent and replicable methodology for analyzing seizure performance as a policy in the context of bilateral or multilateral cooperation among countries. Hopefully extending it even more than an academic exercise, but a contribution to the policy debate. By clarifying what can and cannot be inferred from fragmentary data, this research paper intervenes in a contested space where evidence is instrumentalized for political purposes.

Therefore, the policy arena of fentanyl is structured by three dynamics:

1. Narratives of blame: U.S. externalization of responsibility to Mexico and China, and Mexico's response in the shape of narratives emphasizing U.S. demand.
2. Securitization: The reframing of the public health crisis as an existential security threat, legitimizing extraordinary measures.
3. Asymmetric interdependence: the mutual but unequal vulnerabilities binding U.S. and Mexico in a cycle of cooperation and conflict.

Within this arena, evidence is contested. Seizure statistics, precursor trade flows, and overdose numbers function as political instruments. This makes the development of a methodological framework for handling fragmentary data not only relevant for academia in this topic, but also urgent for informed policy debate.

All this context and problems around the policy arena of fentanyl leaves to the following research question as the core that follows a feasible research that can contribute to Mexico:

How can fragmentary and politically contested data be systematically integrated to measure the dynamics of fentanyl trafficking in Mexico?

Chapter 2. Justification and relevance of the research

The growing crisis of fentanyl trafficking between Mexico and the United States represents not only a public health and security challenge but also a deep epistemological problem. Despite the unprecedented attention it has received from governments , international organizations, and the media; the production, distribution and seizure of fentanyl remain fragmentary, inconsistent, and politically charged. This research is justified by the urgent need to address that gap: to understand how data on illicit economies is generated, and how it can be systematically integrated to produce valid, transparent, and policy-relevant inputs.

At the most basic level, the importance of studying fentanyl in the Mexican context lies in its unique position at the intersection of local and global dynamics. Mexico is both a transit country and a production site, a laboratory of global criminal innovation where domestic institutions, international regulations and transnational markets collide. The U.S. and Mexico border is a historically zone of intense economic integration, and has also become a locus of securitization and diplomatic friction. Within this space, fentanyl operates as a material substance and a symbol for political blame. As the U.S. seeks to externalize responsibility for its overdose epidemic, and Mexico struggles to reclaim its sovereignty and credibility, data themselves become a diplomatic currency.

Therefore, the challenge is not only to describe the problem but to measure it under conditions of uncertainty and political contestation. Existing academic and policy literature on drug trafficking in Mexico focuses primarily on qualitative case studies or on macro-level statistics such as homicide rates or drug seizures. While these approaches provide valuable insights, they don't address the methodological implications of working with incomplete or manipulated data. As Jerven (2013) and Merry (2016) note in their studies of global governance and quantification, numbers are never neutral; they are produced through institutional negotiations, bureaucratic incentives, and symbolic politics. Applying these inputs to the case of fentanyl means recognizing that every data point, seizure, precursor import or enforcement report is not evidence about this phenomenon but also a product of it.

This Research Paper contributes to the field by developing and applying a hybrid methodological framework that allows a potential measurement to support evidence for seizures as a policy tool in the fentanyl arena with fragmentary and politically conditioned data. Drawing from the

literature on shadow economies (Schneider & Buehn, 2016), illicit financial flows (UNODC, 2023; Feiler, 2019) and critical data studies (Kitchin, 2014; Lury & Day, 2019), the proposed approach moves beyond traditional econometric estimation or descriptive reporting. It advocates for a reflexive and reflexing triangulation of data sources, acknowledging uncertainty as part of the analytical process. By systematizing how seizures, precursor imports, and policy events may be cross-referenced, this research paper introduces a replicable design that can be the base of a serious attempt of measuring the fentanyl shadow economy and how seizures affect this illicit economy's income, even having the potential to be replicated in other drug markets or hidden economies.

From a theoretical perspective, this contribution fills a clear gap. Most studies on illicit economies in Latin America are descriptive or criminological in nature. They rarely attempt to build integrated databases capable of showing structural trends or testing correlations under uncertainty. Even less works explicitly question the political conditions under which such data is produced. By positioning measurement as both a technical and political act, this research aligns with the sociology of quantification (Espeland & Stevens, 2008), which seeks to understand how indicators shape reality and governance.

The methodological proposal developed in the research paper also attempts to contribute to the epistemic crisis of the study of drug markets. Traditional econometric models, such as those used to estimate the size of shadow economies (Tanzi, 1999; Schneider, 2016), rely on macroeconomic variables that are largely unavailable or unreliable in the case of fentanyl production. At the same time, purely qualitative approaches cannot provide sufficient comparability or generalization. The hybrid methodology introduced here bridges this division by combining quantitative integration (using incomplete but structured datasets) with reflexive documentation (recording the provenance, reliability, and bias of each observation).

Politically, the research is justified by entering the tension of a "political circus" in the relationship between the U.S. and Mexico: this paper potentially represents an argument for an evidence-based dialogue between these two countries. Current debates around fentanyl are dominated by accusations and symbolic threats (tariff imposals, military cooperation proposals, and moralizing narratives of blame). Policy responses have been reactive, data-poor, and often shaped by electoral cycles rather than empirical evaluation. The absence of coherent data has allowed both countries to build their own narrative of the problem: the U.S. perceives the threat as a "foreign enemy" that brings the poison and death of their people, while Mexico is conscious about the problem they're facing with criminal groups and drug production within, but claims an

overdimension of the issue as an excuse for imposing subordination to their policies. Therefore, a transparent, academically grounded framework for integrating and assessing data can provide a neutral reference point to defog a very manipulated debate.

The most important contribution that this research paper aspires to provide goes in two interconnected senses: the first one is a dataset of all the fentanyl-related seizures that happened in Mexico from Mexican authorities, which is data that is not condensated and compiled by the Mexican authorities and its only spilled across the internet, making this research paper the only source to this day that has all the fentanyl-related data from public sources in Mexico between 2018 and 2025, with a set of variables that could be taken as a base for deepening analysis in future years; and one methodological, by formalizing a replicable approach to data integration under political uncertainty that could be used to measure the impact of seizure policies in hidden economies. The empirical contribution lies not only in estimating the absolute size of the fentanyl market and the legal size of the precursors usage (an impossible task) but in mapping its observable manifestations: the rhythm of seizures, the patterns of precursor imports, and the correlation between enforcement and trade dynamics. The methodological contribution mostly lies in demonstrating how these partial observations can be combined, documented, and validated in a way that maximises transparency and reproducibility.

Another point that highlights the relevance of this research is something that extends beyond the case of fentanyl. As global illicit markets are turning increasingly digitalized, decentralised, and intertwined with legitimate economies, the challenge of data fragmentation will only intensify and that brings a challenge on reflecting more on the qualitative part of numbers and how to interpret quantitative data. For example: in synthetic drugs, money laundering, illegal logging and environmental crimes the data and the issues themselves exists in "shadows of visibility". Developing robust or more critical methodologies for dealing with such phenomena is the main priority not only for academia but for governance and international cooperation.

From a policy standpoint, the research contributes to what Andreas (2022) calls the "politics of border control performance": the tendency of states to use enforcement statistics as evidence of effectiveness, even when such numbers are more symbolic than substantive. By exposing the limitations and biases inherent of official data, the thesis invites policymakers to adopt a more realistic and critical understanding of evidence, one that acknowledges uncertainty and incentivizes transparency rather than directions of performance. In consequence, this aligns with emerging international calls for data governance reforms in the study of illicit flows, as outlined by the UNODC (2023) and the OECD's Global Forum on Transparency (2022).

Finally, this research paper is justified by its potential to reshape the narrative about Mexico's role in the global fentanyl crisis. Dominant narratives like the one in the White House and U.S. media tend to portray Mexico as a passive or complicit actor. By rigorously documenting the institutional and informational issues that shape Mexico's response, this research paper attempts to run a methodology and introduce findings with empirical grounding to a debate often reduced to moral binaries and a more sense-related reflexions. It shows that the scarcity of reliable data is not merely a technical failure but a symptom of a larger political economy on which evidence itself is a form of power.

In conclusion, this research is justified by its attempt to transform epistemic uncertainty into analytical opportunity. By designing a critical and integrative framework that could be replicable for analyzing fragmentary data, this research paper offers a concrete methodological path to observe fentanyl imports shift when the official sources do not cooperate to provide information without political tendencies. Giving insights on how at least any researcher with connectivity can contribute to a shadow economy debate by providing tendencies that are more than valid for any policy arena, specially those that are with cooperative nations.

Chapter 3. Literature review

3.1 Defining and understanding shadow economies

The concept of shadow economy has been widely debated in economics, criminology and mainly in development studies. Definitions vary, a common denominator is that shadow economic activities are productive activities that generate value (profits) but remain deliberately hidden from public authorities in order to avoid taxation, regulation, or law enforcement (Tanzi, 1999; Schneider & Buehn, 2016). These activities may range from relatively benign forms, such as unreported labour or small-scale informal trade, to fully criminal activities such as drug trafficking, money laundering and corruption.

Two distinctions are important for understanding shadow economies. First, not all shadow activities are illegal per se: the informal sector often includes legal goods and services produced without compliance with tax or labor law. In consequence, illegal activities such as drug trafficking fall within the criminal economy, which is often considered a subset of the broader shadow economy. Second, shadow economies are not static: they emerge and expand in response

to structural incentives like high taxation, burdensome regulation, weak enforcement or very profitable illegal opportunities.

Because shadow economies are, by definition, concealed from direct observation, their study requires indirect approaches. The literature identifies several pathways of measurement:

1. Macro-indirect methods: for example, the currency demand approach infers hidden activity from excess cash usage, while MIMIC models treat the size of the shadow economy as a latent variable explained by causes (tax burden, regulation) and proxied by indicators that are present in the observable economy, such as labor participation or electricity consumption.
2. Micro-indirect methods: case-specific studies that reconstruct hidden markets based on fragmentary data such as seizures, enforcement records, or trade anomalies.
3. Hybrid methods: Combining official data, secondary sources, and proxies to build triangulated estimates of illicit markets, often with explicit acknowledgment of uncertainty.

Understanding shadow economies as systems of incentives, concealment, and partial traces is crucial. It legitimizes the use of fragmentary evidence, such as "seizure reports and precursor import statistics" as a valid object of study. In this sense, the fentanyl market in Mexico should be approached not as a sector with measurable official accounts, but as a shadow economy whose size and dynamics can only be approximated through indirect signals that must be curated, triangulated, and critically interpreted.

3.2 Macro Approaches in the Fentanyl micro case

The mainstream literature on shadow economies has been dominated by macroeconomic estimation techniques. Scheinder & Buehn (2016) provide one of the most comprehensive reviews, concluding while each method contributes insights, none can deliver definitive or error-free estimates. Results are sensitive to data availability, assumptions, and model specifications.

This conclusion is critical for this research paper. Even in settings where statistical systems are robust, shadow economy estimates are contested. In illicit drug markets, where data are scarce, politicized, and fragmented, macro approaches are insufficient. Instead, the challenge is to design

a methodology that can operate at the meso/micro level, capturing the flow of fentanyl precursors and the irregular spikes in seizures along Mexico's border with the United States.

3.3 Illicit Financial Flows and Input-Output Accounting

A second strand of the literature on illicit financial flows (IFF) expands on the methodological frameworks developed by the IMF and UNODC that recognize that illegal markets leave only partial regulatory and financial traces, which can be reconstructed into input-output accounts. Zeiler (2019) illustrates this approach in the case of Afghanistan's opium economy, using fragmentary evidence on cultivation, processing, precursors, and exports to produce ranges of estimates rather than exact numbers.

Three methodological lessons from this author apply to fentanyl:

1. Illicit markets can and should be studied through proxy indicators such as precursor trade codes and seizure reports.
2. Triangulation of heterogeneous sources is not a weakness but an accepted standard.
3. Researchers must report uncertainty and limitations transparently, presenting ranges and scenarios rather than single figures.

This legitimizes the proposed dual-dataset design of precursor chemicals and fentanyl seizures as a plausible methodology for analysing the hidden nature of the fentanyl market produced and therefore smuggled into the U.S. border.

3.4 Data-Driven Approaches to Hidden Economies.

The literature on financial crime and money laundering sheds light on the adoption of risk-driven indices. Riccardi et al. (2025) propose combining multiple heterogeneous signals into an index that identifies patterns of anomaly and prioritizes cases with higher risk.

Adapting this approach, fentanyl seizures and precursor imports can be treated as signals to be transformed into a composite monthly index. This would allow:

- Identification of anomalous months or regions where seizures and imports diverge.
- Robustness checks and sensitivity analysis to ensure stability of results.
- Validation of these anomalies against political or enforcement events.

This design turns this research paper from a descriptive correlation into a "replicable" risk-based methodology.

3.5 Triangulation and Transnational Crime

Studies of transnational shadow economies emphasize the necessity of "triangulation". Setyaningrum (2023) argues that illicit activities are "multi-staged" and cannot be captured by a single dataset. Cross-validation across customs, financial intelligence, judicial cooperation, and media is an essential element.

This means that different levels of sources are needed and such a data collection strategy is a valid method in order to add robustness to observations that do not compromise the quality of them. Starting with official press releases, then expanding to national and local media, duplicating and cross-referencing. This method can be theorized as a replicable protocol for studying illicit markets, harmonizing it with the empirical design with broader methodological standards in this research paper.

3.6 Linking Shadow Economies Methodologies to the Fentanyl Case

The fentanyl crisis exemplifies the need for hybrid approaches. Peaks in seizures may reflect political incentives as much as actual supply shifts. Trade codes capture both licit and illicit uses of precursors. Media attributions of cartel involvement often lack judicial confirmation. Recognizing these biases is not a weakness but the foundation of methodological rigor.

Therefore, according to the literature the methodological structure and empirical strategy should consider the datasets built not as endpoints, but modules in a broader method:

- Module A- Seizure dataset: cleaning, deduplicating, typology, conversion to pills/weights.
- Module B- Import dataset: HS codes, normalization, cleaning, contextualization of licit uses.
- Module C- Composite Monthly Index (CMI-FEN): integrating seizures, imports, and enforcement context.
- Module D- Validation: Robustness checks and placebo tests.
- Module E- Political Interpretation: Situating anomalies within U.S. and Mexico's diplomatic tensions.

3.7 Contribution to the Literature

This research paper enters to the debate among three literatures simultaneously and attempts to contribute to the following strands:

1. Shadow economies: by showing how macro concepts can be adapted into meso/micro illicit markets.
2. Illicit financial flows: by applying input-output accounting principles to precursor/seizure data.
3. Data-driven approaches: by proposing a replicable, composite indicator of fentanyl activity in Mexico.

The originality of this research paper does not lie in providing the "true size" of fentanyl trafficking, but in designing a transparent and replicable methodology for studying illicit markets (fentanyl production) under the conditions of data fragmentation and political contestation.

Chapter 4. Methodology.

4.1 Methodological Rationale.

The methodological design of this research was guided by two central principles: first, that measuring an illicit economy requires methodological pluralism: no single data source can capture the complexity of a hidden system. Second, that transparency in data processing is itself a form of validity, particularly when working with contested or politically sensitive information.

Following up with literature on shadow economies (Schneider & Buehn, 2016), the illicit financial flow frameworks (Zeiler, 2019), and data-driven approaches to financial crime (Riccardi et al., 2025), the research design adopts a multi-stage triangulation process. Each stage corresponds to a specific kind of visibility (governmental, journalistic, and statistical) and to a complementary function in the reconstruction of the fentanyl economy.

4.2 Research design.

In order to answer the research question, it is important to state the assumption that fragmentation is an empirical condition of illicit economies and an opportunity for methodological innovation. Fentanyl trafficking is characterized by partial visibility: information

is dispersed across institutional sources, shaped by enforcement priorities and filtered through media representation. Building on this recognition, the chapter presents a hybrid framework designed to transform the fragmented sources into a coherent analytical structure.

The chapter also reflects on the epistemological and ethical dimensions of working with illicit-market data: issues and reliability, duplication, uncertainty, and political bias are treated not as noise to be removed but as meaningful indicators of how knowledge about fentanyl is produced and circulated.

The methodological strategy of this research paper is based on the construction of two original datasets and the merging of those observations: the first one is a dataset of all the fentanyl seizures in Mexico between 2018 and 2025, and another capturing the monthly imports of fentanyl precursor chemicals from China and the United States in the same period. Because no consolidated dataset covering both dimensions exists, it was necessary to have two empirical parallel strategies: to request the data from the ministries and official government institutions to compile this information. Second, to compile these observations with secondary data sourced from the internet and compiled it myself. This chapter will describe the multi-stage process of data collection, validation and integration; as well, the procedures followed, highlighting the sources consulted and the decisions made to ensure consistency and comparability.

4.3 Data collection

4 information request were sent to different data sources in order to receive observations of the following precursor chemicals:

- N-Phenethyl-4-piperidone (NPP)
- 4-anile-N-phenethylpiperidine (ANPP)
- Norfentanyl
- 1-Benzyl-4-piperidone
- 4-piperidone
- Phenethylamine
- Benzyl chloride
- Acetic anhydride
- Propionil chloride
- Oxalyl chloride

In the first request directed to the Agencia Nacional de Aduanas de México (ANAM) known as the national customs office to provide data from 2014-2024 for each precursor chemical, the aim is to receive for each year the following observations:

- Date of entry
- Harbor or custom of entry
- Country of origin
- Volume (in kg or liters)
- Value of the import (in mexican pesos or dollars)
- Custom fraction (Harmonized System code)

The second request is directed to the Federal Commission for Protection against Sanitary Risks (COFEPRIS) where for the same precursor chemicals the objective is to know the direction of the import and how much of the imports go to legal industries as a proxy of how much precursor chemicals are being imported illegaly, by asking for the following observations:

- Total authorized volume of imports
- Name of the authorized companies or institutions
- Industry of destiny (pharmaceutical, academic, industrial, etc.)
- Date of authorization of the imports

On a similar note, a request was sent to the Service of Tributary Action (SAT) to follow-up the origin and destiny of the precursor chemicals imported, requesting the following observations:

- Volume of annual imports
- Country of origin
- Custom office of entry
- Exporting company
- FOB/CIF Value

The last request was directed for the National Institute of Geography and Statistic (INEGI) as they collect and collaborate with the previous institutions mentioned about the same observations as a way of ensuring the data collection on time for any further request or the analysis of the data if possible.

After the responses 40 work-days later, only INEGI provided useful outputs on the data for the "precursor chemical imports" dataset, leaving the strategy of compiling the data from secondary sources the most feasible option for the data collection.

4.4 Construction of the Fentanyl Seizures Dataset

The seizures dataset was constructed through an iterative process of data compilation organised into a series of search "batches". These batches compiled information from official institutions and journalistic sources, progressively increasing in scope.

The first batch (Batch 1) focused exclusively on the northern border of Mexico, reflecting the strategic importance of this region in cross-border fentanyl flows. Data were drawn from official press releases of federal institutions such as the National Defense Ministry (SEDENA), Marine Ministry (SEMAR), Guardia Nacional (GN), and the National Prosecutor's Office (FGR). Given the limitations of official communications (often aggregated and selective) Batch 2 incorporated events reported in national media that explicitly mentioned fentanyl seizures but were not captured in federal releases. Batch 3 expanded the scope further by consulting local and regional press in states such as Sonora, Baja California, Chihuahua and Tamaulipas, allowing the identification of smaller-scale seizures that are frequently omitted from national reporting. Finally, Batch 4 extended the search nationwide, covering all 32 federal entities.

Each new batch was cross-referenced with previous ones to eliminate duplication, particularly in cases where press coverage replicated the contents of official press releases. This iterative batch design permitted a progressive saturation of the dataset, balancing the reliability of official sources with the granularity provided by local reporting. The approach aligns with best practices in criminological research, where triangulation across heterogeneous sources is recommended when studying illicit markets (UNODC, 2022).

Each observation corresponds to a distinct seizure event. The variables collected include the month and year of the seizure, the state and municipality (when available), the reported quantity (in kilograms or pills) the equivalent conversion (0.3 grams per pill), the estimated pill count when only weight was available, and the estimated value in U.S. dollars. The valuation metric follows international references (INCB, 2021), assigning USD 100,000 per kilogram or USD 5 per pill. Attribution to criminal organisations, when mentioned in sources, was also recorded, even if lacking judicial confirmation. The event-level dataset was then aggregated at the monthly level, creating a continuous time series from January 2018 to December 2025.

4.5 Construction of the Precursor Chemical Imports Database

The second dataset was derived from official trade statistics published by INEGI (in their response to the request a tutorial was provided on how to use and download the data from their website). Because there is no single customs code labelled "fentanyl precursors" identification relied on expert recommendations and existing literature, which highlight key precursor categories involved in synthetic opioid production (Ciccarone, 2019). Three tariff codes were selected 2915.90.99.99 as a proxy of N-Phenethyl-4-piperidone (NPP) and Priopinil Chloryde, 2933. 3999 as a proxy of Nortfentanyl, and 2921.42.99 as a proxy of Phenthlyamine which can be understood as the 3 main codes for having the principal precursor chemicals in the database.

For each code, monthly imports from China and the United States were extracted between 2018 and 2025. The raw data required extensive cleaning, as numeric formatting inconsistencies (commas versus points as thousands separators) generated errors in processing. All figures were homogenised into kilograms, and missing values were coded as zero. This process ensured the comparability of monthly import volumes.

While the selected codes do not exclusively correspond to fentanyl precursors, their inclusion is methodologically justified as a proxy measure of precursor availability. This approach follows the precedent established in international monitoring, where aggregate chemical trade flows are used to approximate synthetic drug production potential (INCB, 2022; UNODC, 2022).

4.6 Estimating the Legal Use of Fentanyl Precursors in Mexico

This section of the Research Paper describes and examines the possibility of estimating the legal industrial use of four chemicals frequently associated with fentanyl production, as well as to justify the selection of these chemicals to measure the size of fentanyl ingredients entering the country. N-Phenethyl-4-piperidone (NPP), Propionyl Chloride, Norfentanyl, and Phenethylamine are the precursor chemicals which have monthly observed import values. The goal is to explore how much of these substances might be legitimately consumed across industries such as pharmaceuticals, perfumery, and agrochemicals, and whether public data allow for a proxy estimation of potential diversion of illicit fentanyl production, lastly reflecting on what is needed to correctly estimate how can we know the amount of these chemicals destined to legal industries and therefore assume the volume that might be used for fentanyl production without public data.

4.6.1 N-Phenethyl-4-piperidone (NPP)

NPP is a well-known immediate precursor of fentanyl, the "legitimate" use it may have is almost entirely restricted to the pharmaceutical industry, where it serves as an intermediate compound for the controlled synthesis of fentanyl or certain analogues such as carfentnail (DEA, 2021). Apart from these uses, NPP has no other recognized industrial applications, and international authorities (DEA) have confirmed that its only known function is fentanyl manufacture (INCB, 2022).

NPP was placed under international control in 2017 and added to Mexico's national list of controlled precursors that same year (COFEPRIS, 2017), which makes imports now requiring a COFEPRIS sanitary permit. However, investigative reports have shown corruption and irregularities in the issuance of such permits during 2020-2021, needing federal intervention nowadays (El Universal, 2021).

In conclusion, any measurable imports of NPP into Mexico almost certainly correspond to illicit use. A reasonable proxy for legal consumption would be to assume that only the amount required to produce the country's small medical fentanyl supply (roughly 10 kg of NPP per year or less) can be considered legitimate, therefore the rest likely reflects illicit flows.

4.6.2 Propionyl Chloride

Unlike NPP, Propionyl Chloride has multiple legitimate industrial applications. It is used as a chemical intermediate in the manufacture of pharmaceuticals, agrochemicals, dyes and most importantly fragrances and flavor compounds (Sigma-Aldrich, 2022). In the perfumery sector, it helps synthesize piperonal, a common vanilla aromatic used in soaps and oriental-style perfumes (Fragrance Science, 2021).

Although not controlled under UN conventions, Propionyl Chloride appears on Mexico's national watch list of fentanyl precursors and requires import notification or authorization (SEDENA, 2017). Due to its legitimate applications, trade continues over regulatory oversight.

Public data distinguishing legal versus illicit use are unavailable. However, industrial demands provide some reference. The global market for Propionyl Chloride amounts to several tens of millions of dollars annually (MarketsandMarkets, 2022), while Mexico's legitimate industries (perfume, pharmaceuticals, agrochemicals) would only require tens of tonnes per year at most. Reports indicate that some suppliers in China offered to export 500-1000 litres per month of

Propionyl Chloride to Mexico specially for fentanyl production (Reuters, 2022), a figure far exceeding what domestic fragrance or pharma companies would realistically need.

In conclusion, while part of Mexico's Propionyl Chloride imports clearly serve legitimate purposes, any large or anomalous volumes almost certainly indicate diversion of illicit synthesis. Without access to custom microdata, a reasonable proxy variable is to compare total imports against estimated industrial demand; any significant surplus likely feeds the fentanyl supply chain.

4.6.3 Norfentanyl (Despropionyl Fentanyl, 4-ANPP)

Norfentanyl is the immediate precursor of fentanyl and aside from trace quantities used in research or forensic testing, has no legitimate commercial use. It is not used in perfumery, agriculture or any other legal industry.

The substance was included under international control in 2022 (UNODC, 2022). However, in 2023 The Department of State of the U.S. report noted that Mexico had not yet updated its domestic regulations to include norfentanyl as a controlled precursor, meaning it could technically be imported without authorization (U.S. Department of State, 2023). This created a big loophole between 2018 and 2024 before the update of Mexico's regulations with this chemical.

There are no public trade or seizure records referring specifically to norfentanyl in Mexico. Given its lack of legitimate demand, any detected importation or presence is almost linked to illicit fentanyl manufacture.

In conclusion, all norfentanyl imported or produced in Mexico should be considered 100% illicit material for fentanyl production. A proxy estimate could be developed from future COFEPRIS or customs reports once the compound becomes formally scheduled, but no public data currently exists. Additionally, COFEPRIS and INEGI did not provide a separate report of norfentanyl imports, only providing the HS code (Harmonized System code) that also includes other chemicals that diverge the quality of the finding.

4.6.4 Phenethylamine

Unlike the previous chemicals, Phenethylamine has several lawful industrial uses. It occurs naturally in chocolate and wine and is added as a flavouring or aroma compound in the food and beverage industry (FDA, 2020). It is also used as a dietary supplement and as an intermediate in

the production of pharmaceuticals and specialty chemicals (PubChem, 2021). Some cosmetics and dyes also incorporate phenethylamine (Chemical Weekly, 2022).

Phenethylamine is not controlled under Mexican or international precursors list, as it is not directly used to make fentanyl. It is freely traded and generally imported in small industrial quantities (hundreds of kilograms per year).

Most imported phenethylamine in Mexico is likely consumed legitimately in food, cosmetics, and pharmaceutical manufacturing. Public data on import volume are scarce, but the compound is sold internationally as a fine chemical in standard drum quantities. Any illicit diversion of fentanyl synthesis would be negligible, since traffickers typically import more advanced intermediates (like NPP). Nevertheless, Phenethylamine is a potential choice because of its low-alert chemical for fentanyl synthesis.

In conclusion, the legal use predominates and the best available proxy for legitimate consumption would be trade statistics for the compound under its HS code, crossed-referenced with the size of the Mexican food flavouring and pharmaceutical sectors. At present, there is no evidence of significant misuse.

4.6.5 Measuring Legal vs. Illegal Use With Limited Official Data

Mexico does not publish disaggregated data showing how much of each fentanyl related-related chemical is destined for legal industry versus illicit production. In the findings chapter it will be further discussed the imperativeness of the differentiation between chemical imports for legal purposes due to the nature of the precursor chemicals. Nevertheless, on the data collection process of these imports data, without any information request answered from COFEPRIS, SAT (customs), or SEDENA, only indirect approaches are possible:

- Regulatory analysis: Identify which substances require import permits. NPP and Propionyl Chloride are regulated; Norfentanyl and Phenethylamine are not.
- Industrial Benchmarks: Estimate legal demands based on known industrial uses or information requests to the private sector.
- International trade data: Compare Mexico's total imports (via UN Comtrade) with expected consumption in legitimate industries
- Contextual cross-checking: Correlate import anomalies with seizure data or production estimates for illicit fentanyl.

Summary Table (Personal Qualitative Estimate)

Chemical	Legitimate Use in Mexico	Legal Share (approx.)	Illicit Diversion Risk
NPP	Controlled fentanyl synthesis	0-1%	Very High
Propionyl Chloride	Fragrances and pharmacological intermediates	20-30%	High
Norfentanyl	None (only for research purposes)	0%	Very High
Phenethylamine	Food, cosmetics and pharmacological industry	90-100%	Low

Between 2018 and 2025, no publicly available datasets provided a clear figure for Mexico's legal consumption of fentanyl precursors and COFEPRIS did not provide a favourable answer to the information request to have a better understanding the actual size of the legal economy of the fentanyl precursor chemicals. However, by potentially triangulating industrial applications, import records, and regulatory frameworks, it could be possible to approximate their lawful share:

- NPP and Norfentanyl: essentially no legitimate demand in Mexico. Any imports could imply illicit intent.
- Propionyl Chloride: Partial legal use, but total import volumes likely exceed legitimate industrial requirements.
- Phenethylamine: mostly legitimate consumption, minor risk of diversion.

In the absence of official data, the mostly reliable proxy would be to contrast total import volumes with Mexico's known capacity for producing legal goods that require these chemicals (perfumes, chocolate, pharmaceuticals). Any surplus is a reasonable indicator of diversion toward illicit fentanyl synthesis. This is analysed prior to star crossing the imports data with the seizures dataset, therefore in the findings section and conclusions for improving this section of the fragmentary data, more practical suggestions for implementing these inputs will be deepened in order to make the implementation of the methodology more feasible.

4.7 Integration of the Datasets

After cleaning, both datasets were integrated into a unified panel. The key identifier is a month year code expressed "m.yy" (for example, "1.18" = January 2018, "12.25" = December 2025). Each row corresponds to a single month and contains the number of seizures recorded, the total kilograms seized, the estimated number of pills, the estimated monetary values in U.S. dollars, the list of states where seizures took place, and the kilograms imported of each chemical from China and the United States.

The integration required harmonising temporal patterns, as trade data are consistently monthly while seizures were recorded at event level. By aggregating seizures into monthly totals, the panel enables direct temporal comparison. This procedure allows the exploration of correlations between the two phenomena and the identification of possible lead-lag relationships.

The analysis combines descriptive statistics, geographical mapping, and temporal visualization. First, descriptive statistics provide annual total seizures and precursor imports, as well as measures of central tendency and dispersion. Second, visualisations such as time series, bar charts, and choropleth maps are employed to identify spatial and temporal patterns. Third, correlation analysis is used to explore the relationship between precursor imports and seizures, paying attention to whether increases in imports precede surges in seizures. The triangulation of these methods ensure both descriptive depth and exploratory inference.

This methodological design demonstrates how fragmented and heterogeneous data can be systematized to shed light on illicit markets, while also highlighting the need for institutional improvements in official monitoring systems.

4.8 Reliability, Bias, Reflexivity

Working with fragmentary data introduces several layers of uncertainty:

- Reporting bias: Official releases emphasize successful operations and omit failures.
- Attribution bias: Media sources may exaggerate cartel involvement.
- Temporal inconsistency: Agencies change reporting frequency and categories.

To manage these issues, every dataset entry includes a "source-reliability tag (official = high, national press = medium, local press = variable). Missing values were coded explicitly as "null" so they do not interfere with the statistical analysis

More fundamentally, the methodology recognizes that the act of data collection is part of the phenomenon under study. Seizure data do not merely reflect reality, it produces a version of it, serving political and institutional agendas. This reflexive posture adopted here aligns with critical perspectives on the "politics of quantification" (Merry, 2016; Jerven, 2013), which emphasize that transparency about uncertainty enhances rather than weakens validity.

4.9 Ethical Considerations

Although the study relies on public and secondary data, ethical concerns arise from handling information related to criminal activities. Precautions were taken to avoid reproducing stigmatizing or sensationalist narratives, even the ones that may be related to my personal beliefs. No individual-level or identifiable data were included, and all journalistic material was cited according to academic standards.

Chapter 5. Data Analysis and Descriptive Statistics

This chapter presents a descriptive analysis of the two original datasets: fentanyl seizures in Mexico and imports of precursor chemicals from China and the United States. The section first describes the scope and distribution of seizures, then examines the dynamics of precursor imports, and finally considers their relationship. Both tables and figures are provided to illustrate temporal patterns and highlight key insights.

5.1 Descriptive Statistics of Fentanyl Seizures

In the case of the Fentanyl Seizures dataset, it comprises 100 recorded cases collected from official and press sources, categorized by date, state, agency, drug form, and tentative criminal attribution.

The objective of this section is not only to provide a numerical overview but also to interpret spatial, institutional, and temporal patterns that shape Mexico's fentanyl economy. Special emphasis is placed on the political transition from president Lopez Obrador (2018-2024) to Claudia Sheinbaum (October 2024-onwards), assessing whether this regime change correlates with observable variations in seizure dynamics.

To prevent analytic distortion due to the qualitative changes in nature within seizures, I separated them into two different categories:

- Processed fentanyl: found in the form of pills, powder, ampoules, and paste (reflecting downstream production and export)
- Precursor chemicals: precursor compounds (representing upstream industrial supply).

This disaggregation allows for a more accurate interpretation of enforcement patterns and market segmentation. While building the dataset, a common pattern that distinguished both categories was the huge amount of kg seized in precursor chemicals, making the spatial analysis biased in terms of quantity and agencies, because all of the precursor seizure occurred in custom offices and harbors, therefore the comparison between Sonora who has most fentanyl seizures and Colima who has a harbor in Manzanillo, similar hotspots for fentanyl seizures, which is not the case. The same thing happens with the Marine Ministry (SEMAR) because they seize almost all precursor chemicals due to their operations being in custom offices, potentially overstating their participation in seizures compared to other agencies. Treating both as a single dataset would overrepresent the maritime dimension, masking the diverse operational logistics that occur in Mexico's fentanyl economy

5.1.2 General Overview

Between 2018 and 2025, a total of 100 fentanyl-related seizures were documented, corresponding to 243,793.52 kilograms of seized material. When disaggregated by form, 79 cases (133,195.53 kg) correspond to processed fentanyl and 20 cases (110,564.99 kg) to chemical precursors, while one case (33.0) could not provide the form in which the fentanyl was found, therefore was classified as "unknown".

This segmentation highlights the coexistence of two distinct operational systems: first, the industrial-scale maritime precursor imports and secondly, smaller but higher-frequency seizures of processed fentanyl destined for export to the U.S. or domestic distribution.

For the 79 total processed fentanyl observations, there is a mean of 1,686 kg per event, but what does this data say on describing the supply chain of fentanyl and the government's response in Mexico?

First of all, the distribution is highly right-skewed, this means that a few large seizures push the mean upwards while most events are small or medium sized. Emphasizing where potentially is the shift of these mega seizures according to the policy arena in which this data is within.

If we divide this information by political regime, despite the differences in event size, in AMLO's regime there is an extremely high variance, mostly driven by "mega seizures". On the other hand, for the Sheinbaum's administration both the mean and variance collapse, this due to the presence of many small seizures and no major events.

For precursor chemicals the central tendency and dispersion data describes a very different scenario. The first regime (AMLO) concentrates 90% of the precursor seizures, having highly variable large seizures across different locations. Sheinabum's administration has 2 events recorded so far, but these seizures have reached almost half the amount of kilograms seized in the whole 6 years of AMLO's regime, having extremely large cases that will be further discussed.

5.1.3 Spatial Distribution

For processed fentanyl (pills, powder, ampoules, paste) seizures, they were heavily concentrated in the northwest corridor of the country by cumulative volume are:

- Sinaloa: 125,189.14 kg (15 events; mean 8,354 kg)
- Sonora: 3,769.79 kg (15 events; mean 251 kg)
- Baja California: 3,690.78 kg (16 events; mean 231 kg)
- Campeche: 188.70 kg (1 event)
- Mexico City: 116.10 kg (11 events; mean 10.55 kg)
- Querétaro 46.96 kg (5 events; mean 9.39 kg)

Table 5.1.3a States for fentanyl seizures by quantity (total kg).
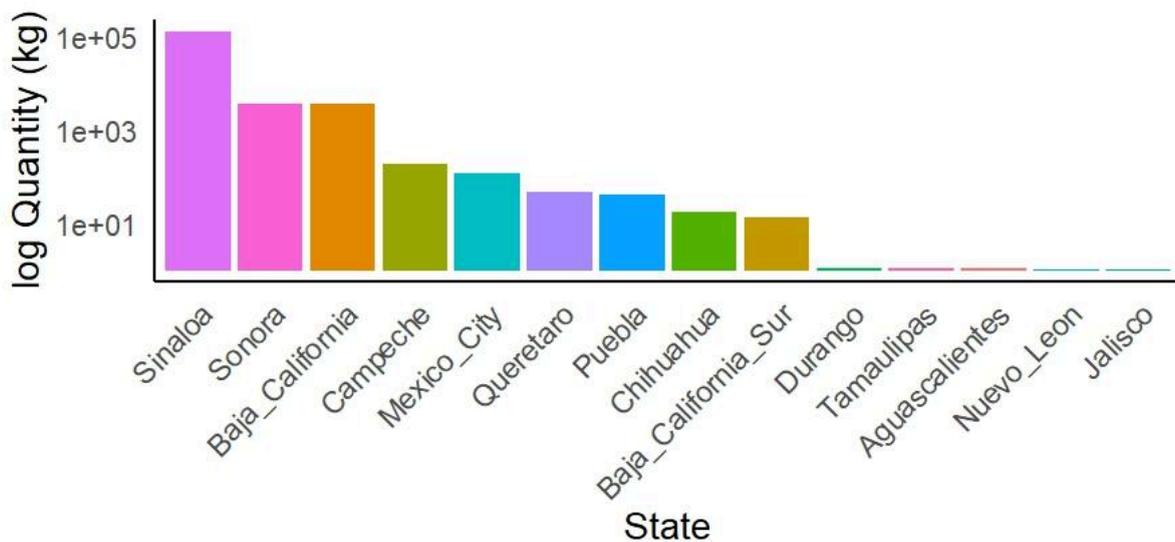
Figure 5.1.3b Heat map of seizures of processed fentanyl

Heatmap of fentanyl seizures by state

Spatially, these seizures delineate two overlapping circuits. First, Sinaloa acts as both a production and consolidation hub, reflecting its logistical dominance in synthesis and tableting. Second, Sonora and Baja California show higher frequency but smaller seizures, which reflects export-oriented interdiction with the northwest border, making it the hottest spot for seizure activity in Mexico. This structure corresponds to the northbound trafficking route identified by the DEA (2024) as the principal export corridor for Mexico's finished fentanyl products.

For the rest of the states in the country the data highlights very interesting insights on how the supply chain of fentanyl is traced down across Mexican territory. For both types of seizures, Mexico City and Queretaro represent central corridors that logistically enable transshipment of both processed fentanyl and precursor chemicals. The cases registered in Zacatecas and Campeche (south-east state in Mexico) represent the diversification of routes and a potential expansion within the Pacific-north axis where the rest of the cases rely.

Finally, there is evidence to claim that Mexico's fentanyl system is bifurcated: the upstream supply (precursor chemicals and everything that exists before fentanyl "cooking") is concentrated in the Pacific coast, with maritime and containerized imports of chemicals. The downstream supply (processed fentanyl) is really concentrated in the northwest and border regions of the country (with few exceptions) that presume a terrestrial pathway with an aim of export towards the U.S.

5.1.4 Chemical Precursors

Precursor seizures, by contrast, are concentrated along Pacific maritime routes, the top contributing states are:

- Colima: 91,614.0 kg (3 cases; mean 30,538 kg)
- Zacatecas: 10,950.0 kg (1 case)
- Sinaloa: 7,769.0 kg (1 case)
- Baja California: 69.17 kg (1 case)
- Mexico City: 34.63 kg (7 cases; mean 4.95 kg)

Table 5.1.4a States for fentanyl seizures by quantity (total kg).
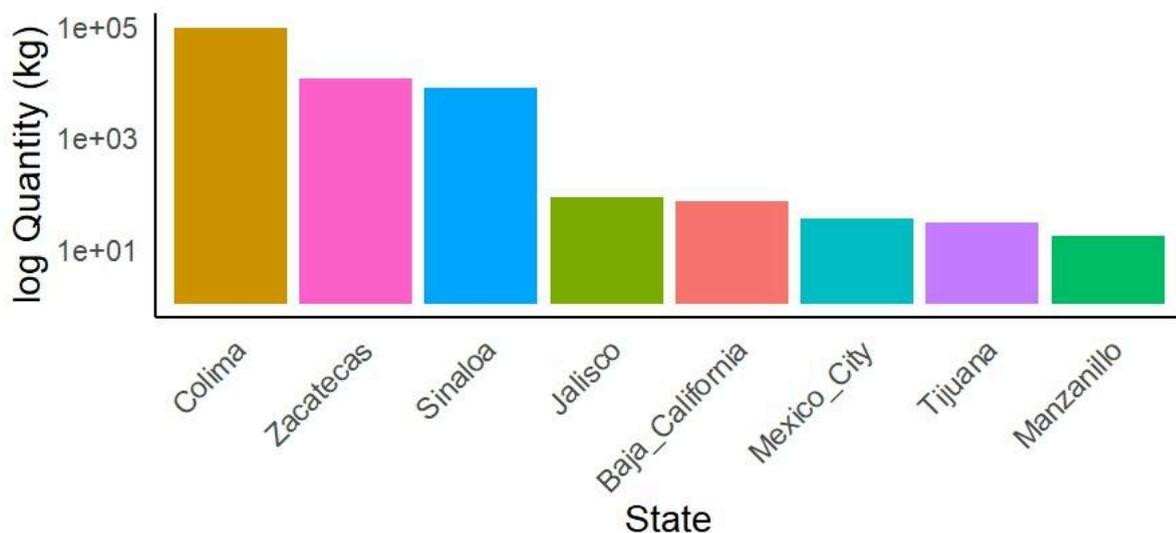
5.1.4b Map of Precursor Flows across territory

Heatmap of precursor seizures by state
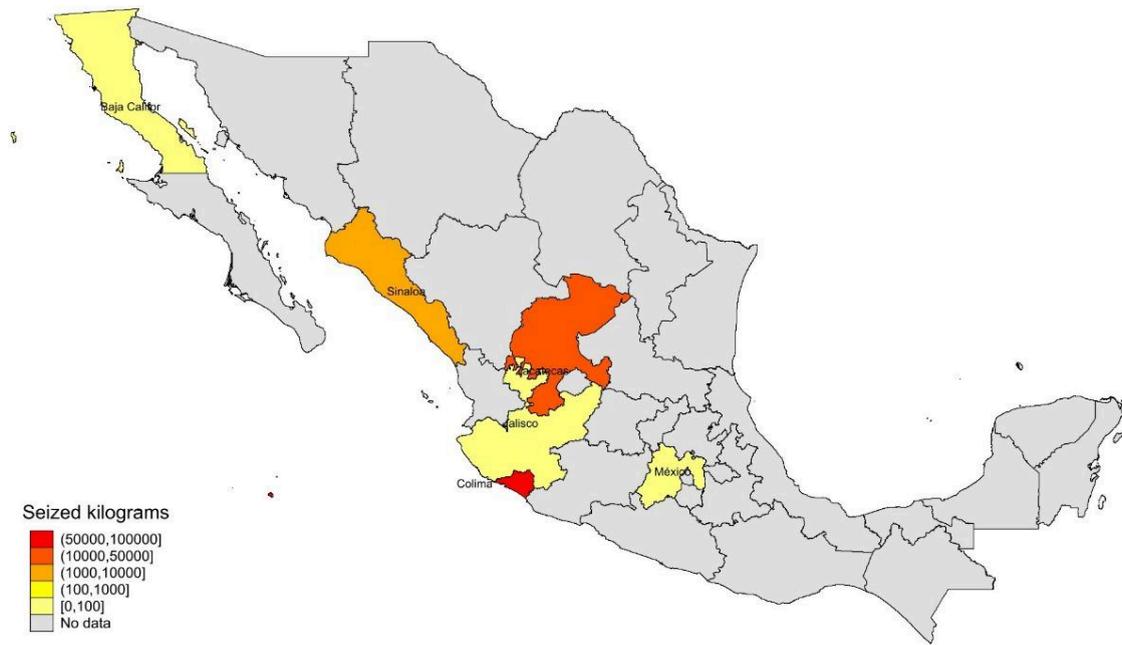
The Pacific coast, particularly Manzanillo (Colima) and Mazatlan (Sinaloa), continues to represent the gateway for precursor chemicals imported primarily from Asia, which provides evidence for the claim of a supply chain of precursor chemicals provided from China, lately manufactured into fentanyl by Mexican criminal groups, and lastly distributed into the U.S. as either pills or powder.

5.1.5 Institutional Patterns

The distribution of processed fentanyl seizures by enforcement agency underscores Mexico's militarized anti-drugs framework:

- SEDENA (Army): 127,265.31 kg (20 events; mean 6,363 kg)

- FGR (Attorney General's Office) 3,678.16 kg (10 events; mean 367.8 kg)

- SSPC (Public Security Ministry): 1,183.49 kg (9 events; mean 131.5 kg)

- Federal Police: 613.46 kg (10 events; mean 61.3 kg)

- State Police: 324.76 kg (5 events; mean 65.0 kg)

- Guardia Nacional (National Guard): 130.35 kg (23 events; mean 5.7 kg)

5.1.5a Bar Chart of Institutional seizures by Quantity (kg.)
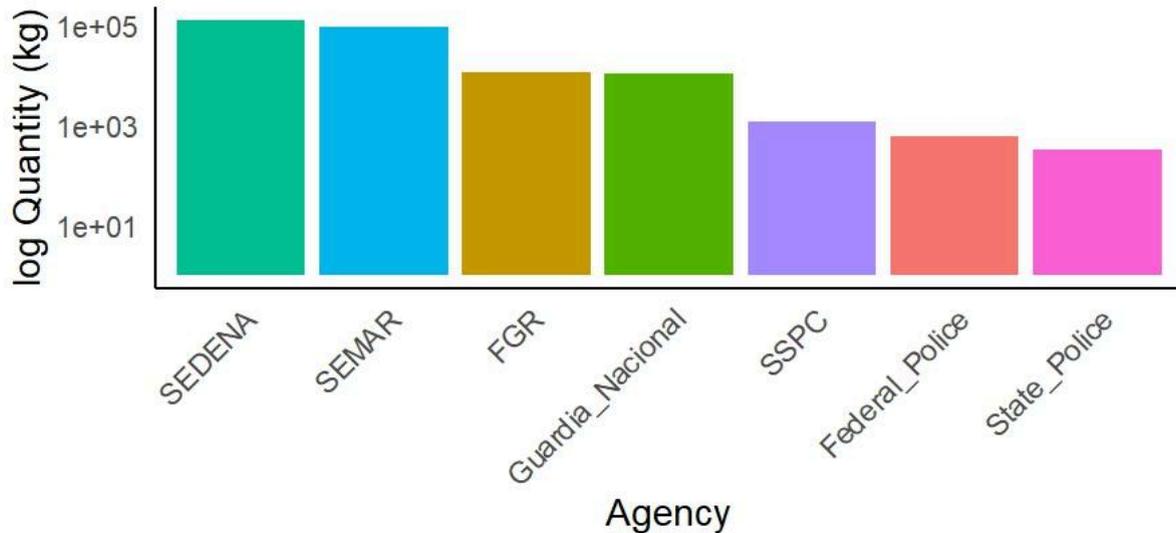
The dominance of SEDENA indicates continued military leadership in large-scale terrestrial interdiction operations, while GN and police forces manage frequent but small volume seizures. This institutional asymmetry reflects the persistent militarization of drug enforcement (Astorga, 2021) and the relative weakness of civilian law enforcement in synthetic-drug control.

In the case of precursors, operations are led almost exclusively by SEMAR (Navy):

- SEMAR: 91,845.99 kg (18 events; mean 5,103 kg)
- National Guard: 10, 950.00 kg (1 event)
- FGR: 7,769.00 kg (1 event)

This division of labor is functionally coherent: SEMAR controls ports and maritime logistics, while SEDENA oversees land-based operations and GN acts as the connective enforcement layer. Such institutional segmentation supports efficiency but reinforces a vertically militarized model of governance that limits transparency and civilian oversight.

5.1.6 Typology of Drug Form

Among the 79 processed cases, the distribution by form is as follows:

- Pills: 132,228.73 kg (58 cases; mean 2,280 kg)
- Powder: 824.13 kg (11 cases; mean 74.92 kg)
- Paste: 118.00 kg (1 case)
- Ampoules 24.67 kg (7 cases; mean 3.52 kg)
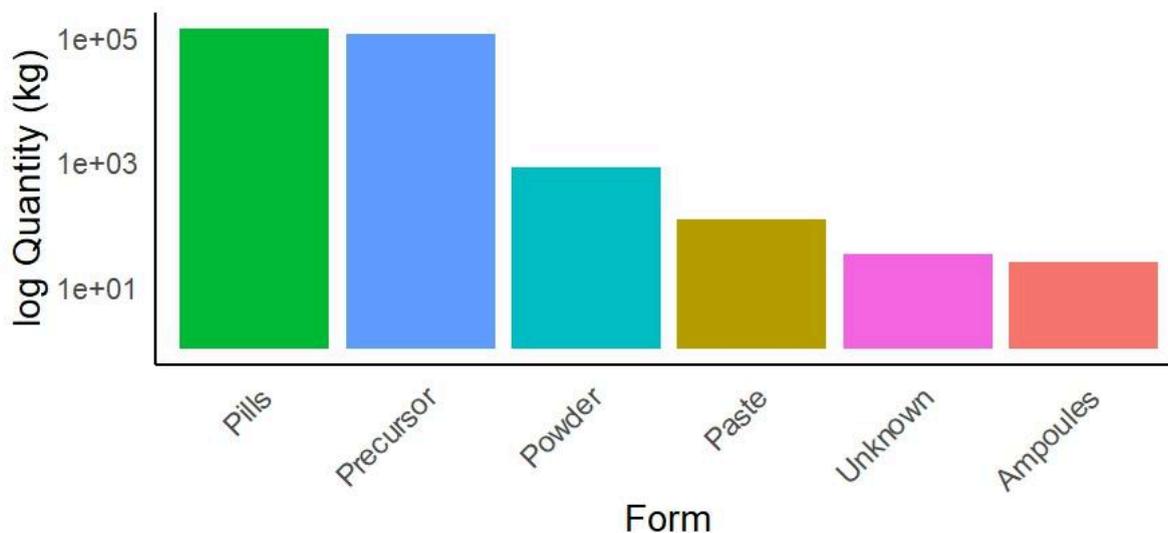
The predominance of pills confirms the presence of a robust tableting infrastructure, capable of mass producing export ready fentanyl. Smaller seizures of powder and ampoules likely represent domestic use or intermediate processing, while the single "paste" event suggests the presence of semi-processed material within the supply chain.

5.1.7 Temporal Comparison: Regime Change

In order to incorporate the policy arena set for fentanyl economy, there is a need to examine whether the political transition affected fentanyl enforcement, the dataset is divided into the two political regimes with the threshold of October 2024:

Table 5.1.7 a Processed Fentanyl Seizures by Regime.

Regime	Cases	Total KG	Mean	SD
AMLO (2018-Sept 2024)	58	128,355.10	2,213.02	16,160.01
Sheinbaum (Oct 2024-2025)	19	4,840.43	254.76	786.03

During the Sheinbaum administration, average seizure size fell nearly 90%, while frequency remained relatively constant. This may indicate a shift toward smaller, intelligence-based

operations, or alternatively a temporary standby in large-scale seizures due to administrative transition. Nonetheless, enforcement activity appears continuous, but less dominated by mega-seizures.

Table 5.1.7 b Fentanyl Precursor Seizures by Regime.

Regime	Cases	Total KG	Mean	SD
AMLO (2018-Sept 2024)	18	74,614.99	4,145.28	12,167.28
Sheinbaum (Oct 2024-2025)	2	35,950.00	17,975.00	9,934.85

Despite the unevenness in cases, the precursor seizures under Sheinbaum's administration are exceptionally large compared to the mean under the other regime's seizures, demonstrating continuity in maritime interdiction and possibly improved targeting of industrial-scale shipments. Together, the two suggest that upstream interdiction remains strong, while downstream interdiction has become smaller and more selective.

Based on the data collected, interesting analysis can be done for crossing what the evidence suggests against the political discourses behind the regimes in Mexico's presidencies. For the operative patterns there is a difference in favour of Sheinbaum's rhythm for seizures in processed fentanyl (event/month), with AMLO presenting 0.86 events per month compared to 1.46, highlighting a difference in political focus in having more seizures over time.

Another aspect that differs between regimes is in terms of volume, the mean of kilograms seized for Sheinbaum's regime is 255 kg (a reasonable size) compared to the 2,213 kg in average seized during AMLO's administration. This sheds a light on where does the difference rely between them: Under Sheinbaum the tendencies show more operatives, smaller in quantity and less variable, presumably related with an intelligence strategy to show cooperation to the international community.

The logic changes for analysing precursor chemicals seizures. AMLO recorded a frequency of 0.26 events per month, with a drop from the new regime recording so far 0.15 events/month. Nevertheless, the amount of seizures has considerably increased from a mean of 1,066 kg with AMLO to 2,765 kg with the current administration, generating a shift in the strategy rather than a change in the policy per se.

In sum, according to the data Sheinbaum has not seized more or less in terms of total quantity, but rather shows another style. The downstream industry shows more seizures in less quantity, and for the upstream (precursor) the cases dropped compared to the past regimes, but has larger amounts seized. Following what has been set in the policy arena by the Trump Administration that wills Mexico to stop the precursor imports coming from China with a focus on quantity to reduce the supply for criminal groups. As well, increasing seizures of processed fentanyl with detentions to these criminal groups to reduce impunity and weaken their operational structure.

To conclude, Sheinbaum structurally does not shift the political pattern of her predecessor, but addresses the demands that the policy arena in which Mexico does not have leverage, adapting the strategy without sending a message of subordination within the country.

5.1.8 Discussion

The results reveal a dual and persistent structure within Mexico's fentanyl enforcement landscape:

1. Upstream dimension (precursors, maritime)

    Concentrated in Pacific ports and managed by SEMAR, these seizures are infrequent but massive, reflecting industrial inputs and containerized transport. Their relative stability across administrations highlights the institutional inertia of naval enforcement.

2. Downstream dimension (processed fentanyl, terrestrial)

    Concentrated in Sinaloa, Sonora, and Baja California, and dominated by SEDENA and GN, these seizures are frequent but small in comparison to precursor seizures. The sharp reduction in volume post-2024 suggests tactical reorientation rather than structural change, or possibly a shift from mass confiscations to more intelligence-led enforcement

3. Continuity under regime change.

    Despite political transition, the fundamental architecture of fentanyl enforcement (military dominance, Pacific entry points, and northern export routes) remains intact. This indicates path dependency in Mexico's anti-narcotic institutions (Snyder & Duran-Martinez, 2022) where organizational and logistical inertia limit rapid policy transformation.

In conclusion, while quantitative volumes fluctuate, the structural geography and institutional configuration remain consistent across political regimes. This descriptive evidence provides a robust empirical foundation for subsequent inferential chapters exploring causal dynamics and policy implications.

5.2 Descriptive Statistics of Precursor Imports

As reported by the media and other sources, China is the biggest exporter of precursor chemicals as the start of the supply-chain with Mexico (Walsh, Brewer and Isacson, 2024; E. Barnes *et al.*, 2025; Krever, 2025; Ferragamo and Klobucista, no date). Therefore, imports from China are central for confirming claims on China's precursor supplier role. On the other hand, sources like (Moore, Olney and Hansen, 2024) have raised questions regarding a potential leading role in the U.S. for the smuggling and legal exportations of precursor chemicals into Mexico. To empirically contrast these claims the imports from both the U.S. and China are tracked down between 2021 and 2025.

Linking these countries with the precursor chemicals is a task with methodological limitations. From the source of INEGI the total kg of imports of these chemicals is tracked with a monthly report, nevertheless, these chemicals are also used in other industries that are not related with drug trafficking. Therefore, the main precursor chemicals that are the principal ingredients for its preparation were included with the coding where the source claimed they are located within their files and statistics. Three codes were tracked: 2915.90.99.99, 2933.3999, and 2921.42.99.

Table 5.2a Annual imports of chemical 2915.90.99.99 (kg)

Year	USA (Weight kg)	China (Weight kg)
2021	4,806,259	774,669
2022	null	null
2023	8,163	774,669
2024	7,169	788
2025	3,287	705

Table 5.2b Annual imports of chemical 2933.3999 (kg)

Year	USA (Weight kg)	China (Weight kg)
2021	null	null
2022	2,643,697	11,376,890
2023	1,509,113	10,508,940
2024	465,672	12,097,936
2025	114,039	8,831,497

Table 5.3c Annual imports of chemical 2921.42.99 (kg)

Year	USA (Weight kg)	China (Weight kg)
2021	null	null
2022	null	null
2023	null	460,001
2024	16,013	175,272
2025	64,006	209,790

Table 5.2d. Combined imports of 3 chemicals by China and USA (2021-2025)

Year	USA (Value USD)	China (Value USD)	USA (Weight Kg)	China (Weight Kg)
2021	19,865,152	3,568,255	4,806,259	774,699
2022	24,481,489	79,256,330	2,643,697	11,376,890
2023	18,375,904	47,595,420	1,517,276	10,969,710
2024	6,769,238	47,233,480	488,854	12,274,000
2025	1,677,711	27,081,400	181,332	9,041,992

5.2.1 Temporal distribution and general trends.

a) Magnitude and central tendency

Across all codes, the total imports vary substantially from year to year, reflecting changing industrial demand and possibly adjustments in custom oversight. For 2021-2025 (the best overlapping period with seizure data):

- Mean annual imports: 9.8 million kg

- Median annual imports: 12.5 million kg

- Standard deviation: 4.3 million kg

- Coefficient of variation: 44% (indicating high year to year volatility)

These statistics reveal that import volumes fluctuate sharply, which could be influenced by both economic and regulatory factors such as changing supplier countries, chemical substitution, or enforcement cycles.

b) Yearly pattern and volatility
- 2021: imports were moderate (775,000 kg), making a baseline level after the pandemic related contraction in global trade
- 2022: a sudden surge (14 million kg), which is the highest value in the series. This spike likely reflects the normalization of supply chains and possibly stockpiling by the chemical or pharmaceutical industry as pandemic restrictions eased.
- 2023-2024: volumes remained high (12.4-12.8 million kg), suggesting a new structural plateau rather than a one off rebound.
- 2025 (partial year) the value decreases to 9.2 million kg, though it remains above pre-2021 levels.

The temporal pattern therefore displays post 2021 escalation in imports, consistent with broader international trade recovery, but possibly also reflecting increased chemical availability relevant to the synthetic drug market.

c) Skewness and outliers

The distribution of annual totals is right skewed, dominated by the exceptionally high figures of 2022-2024. When log-transformed, the series approximates normality, confirming that the variability stems mainly from a few very large annual imports total. This pattern underscores the importance of a small number of high volume import years in shaping overall precursor availability.

5.2.2 Correlation with Seizure Data

When the import and seizure datasets are merged by year (see Section 5.2.3), a weak positive temporal association can be observed: years with higher import totals (2022-2024) also correspond to larger precursor seizures, especially 2024. Although correlations do not imply causation, this pattern is consistent with heightened exposure and enforcement effort during years of greater chemical inflow.

However, 2023 stands out as an exception: despite very high import levels (12.5 million kg), no precursor seizures are recorded in the dataset. This disconnect could reflect delayed enforcement, data gaps, or a temporary pause in maritime interception capacity. The 2023 anomaly is therefore an important warning for interpreting year to year seizure to import ratios.

5.2.3 Measures of Dispersion and Structure

Statistic	Value (kg)	Interpretation
Mean	9,850,000	Baseline annual flow (large legal supply)
Standard Deviation	4,300,000	High interannual variability
Minimum (2021)	774,699	Post pandemic low baseline
Maximum (2022)	14,020,587	Exceptional rebound year
Range	13,245,888	Illustrates amplitude of fluctuation
Coefficient of variation	44%	Indicates moderate to high volatility

These descriptive statistics confirm a dynamic import regime with irregular peaks and lows (typical of chemical markets with shifting regulatory and industrial pressures. For policy analysis, high volatility implies that any diversion risk assessment must be time sensitive, as "average" values conceal sudden surges in availability.

5.2.4 Synthesis and implications

The descriptive statistics highlight three core findings:

1. **Large baseline volume:** even in low years, the inflow of relevant precursor chemicals is substantial.

2. **Sharp volatility:** post pandemic years exhibit major oscillations (up to 20 times difference between 2021 and 2022).

3. **Potential systemic linkage:** years of high imports tend to coincide with increased seizures, suggesting that enforcement intensity may be reactive rather than proactive.

All together, the import data frame the broader policy question: How much of this legal inflow can realistically be monitored? If enforcement remains active, peaks in legitimate imports may coincide with expanded opportunities for diversion before oversight mechanisms adjust.

5.3 Discussion

The descriptive analysis reveals a long-tail distribution of seizures dominated by rare but massive interdictions, typological diversity of forms with pills and powder playing distinct roles, and criminal attribution patterns pointing at the Sinaloa Cartel's corridor dominance. Source heterogeneity highlights the value of triangulating official and press data. The alignment of precursor imports and seizures suggests structural independence between licit and illicit forms, consistent with theories of adaptive illicit markets (Andreas, 2019; UNODC 2022).

5.3.1 Scenario Analysis: Imports, Diversion and Production Potential

This subsection explores the supply risk posed by legal imports of fentanyl related precursor chemicals. Using the national import dataset provided (three tariff codes aggregated by year) and the seizure dataset described in previous sections, I model three hypothetical diversions in which 1%, 5% and 10% of annual imports are illicitly diverted to clandestine fentanyl production. For each scenario I compute:

1. Annual diverted precursor mass (kg).
2. The fraction of that diverted mass that was actually interpreted by seizures of precursors in the same year (interception percentage).
3. The potential mass of finished fentanyl that could be produced from the diverted precursors under two conversion assumptions: (a) 1:1 (1 kg of precursor yields 1 kg of fentanyl) and (b) 1:0.2 (more conservative, with a realistic mass yield).

The 1:0.2 conversion is used analytically as a conservative estimate to reflect process losses of the natural product formation, incomplete conversion and crude clandestine operating conditions; this assumption is supported by laboratory yield variability and law-enforcement analyses noting that illicit synthesis rarely achieves laboratory-scale yields (Valdez, 2014).

Year	Imported qty (kg)	Precursor seized (kg)	Processed (kg)	Diverted 1% (kg)	% intercepted (1%)	Diverted 5% (kg)	% intercepted (5%)	Diverted 10% (kg)	%Intercepted (10%)
2021	774,669	56.03	183.66	7,746.99	0.72%	38,734.95	0.14%	77,469.90	0.07%
2022	14,020,587	16,801.36	669.88	140,205.87	11.98%	701,029.35	2.40%	1,402,058.70	1.20%
2023	12,478,823.42	0.00	123,857.82	124,788.23	0%	623,941.17	0%	1,247,882.34	0%
2024	12,755,681.25	32,769	1,112	127,556.81	25.69%	637,784.06	5.14%	1,275,568.12	2.57%
2025	9,220,037.44	10,950	3,738.43	92,200.37	11.88%	461,001.87	2.38%	922,003.74	1.19%

The results of this scenarios and the interpretation are divided as follows:

a) Scale and risk

The import volumes are large (hundreds of thousands to millions of kilograms per year). Consequently, even a 1% diversion corresponds to tens or hundreds to thousands of kilograms of precursor feedstock, which is sufficient to produce large quantities of finished product under moderate conversion yields. This observation alone shows why small diversion rates can outsize implications for illicit production capacity.

b) Interception effectiveness (by year)

Across the five years analyzed, the proportion of the hypothetical diverted precursor mass that was actually seized varies widely:

- In most years, interception rates are very low (<5% for many year/percentage combinations).

- 2024 is an exception: because the seizure dataset records a very large precursor interception that year (32,769 kg), interception reaches around 25.7% of the 1% diversion scenario in 2024. This single year illustrates how a few large maritime interceptions can materially alter the annual interception rate. However, reliance on sporadic big seizures produces unstable annual protection: if large arrests do not occur, interception coverage falls sharply the following year (as seen for 2023 in this dataset).

c) Potential finished product comparison

Using the conservative conversion 1:0.2 (20% mass yield from precursors to final usable fentanyl mass), the 1% diversion in 2024 (around 127,557 kg diverted) could, in theory, yield 25,511 kg of finished fentanyl. By contrast, processed fentanyl seized in 2024 in the dataset totals 1,112 kg. This gap indicates that current processed seizures would intercept only a small slice of the potential downstream output even in a year with large upstream seizures. The disparity becomes more acute under 5% or 10% diversion scenarios.

Analyzing why the 1:0.2 conversion assumption is defensible. Laboratory syntheses of fentanyl under optimized conditions can produce high step yields (some published synthetic methods report high isolated yields for optimized reactions), but clandestine synthesis and downstream processing tend to be less efficient and produce lower overall mass yields due to imperfect reagents, impure intermediates, reaction losses and dilution when formulating tablets or mixtures (DEA & DOJ technical documentation). As it was mentioned in previous descriptions of how fentanyl production takes place in Mexico, clandestine production dominates structural operations in the desert zone for border operatives in the country, making this a relatable assumption for the context. For these reasons, a 20% mass yield (1:0.2) provides a cautious, policy relevant lower bound for the conversion of precursor mass into final fentanyl mass.

The policy implications that can be taken from the data compiled and analyzed in this scenarios are the following:

1. **Interdiction alone is insufficient.** Even large seizures (while politically and operationally significant) are unlikely to remove more than a minority share to potential diverted inputs, unless interdiction becomes systematic and sustained at the scale of total imports.
2. **Target upstream controls.** The results show that measures targeted at diversion prevention (licensing, traceability, container scrutiny, upstream supplier controls) are likely to be more effective per unit of effort than standing alone seizure operations.

International cooperation to control specific HS codes and supplier monitoring is essential. (UNODC/INCB policy emphasises this approach.)

3. **Data and reporting gaps matter.** Years with zero recorded precursor seizures (for example 2023 in this dataset) produce large uncertainties. Strengthening reporting pipelines, improving source transparency, and harmonizing seizure datasets would improve the reliability of mass balance risk assessments

The limitations that this analysis potentially presents are firstly a mass based examination that ignores purity and formulation differences. It therefore provides an upper bound perspective on the material risk associated with diverted precursors. Secondly, the conversion yields are uncertain; the 1:0.2 scenario is conservative but still an approximation, therefore further lab of forensic studies on clandestine yields for the exact precursors would tighten this parameter.

Finally, scenario modeling indicates that small diversion rates (1-10%) of legally imported precursor mass are sufficient to create a production capacity that greatly exceeds current seizure levels. In practice, only systematic upstream controls combined with targeted interdiction and improved intelligence are likely to reduce the material base available to clandestine fentanyl manufacture.

6. Findings and Methodological Implications

6.1 Introduction

This chapter synthesizes the main empirical and methodological findings arising from the integration of two original datasets:

(1) Fentanyl Seizure Dataset (2018-2025) and
(2) Precursor Imports Dataset (2021-2025).

The analytical contribution of this research paper lies not only in what these datasets reveal, but in what ways their gaps and inconsistencies exposed about the politics of data production surrounding fentanyl in Mexico. Because the two datasets were built from fragmentary data and contested sources (press release, customs tables, and scattered official communications) each carries both evidentiary and epistemic significance. Their absences, time truncations and incompatibilities are findings in themselves, illustrating the structural opacity of Mexico's data regime on synthetic drugs.

6.2 Core Empirical Findings

6.2.1 Uneven Temporal Coverage

The Precursor Import Dataset begins only in 2021, as no reliable public trade data was available for earlier years under the relevant HS codes. This four year window (2021-2025) overlaps only partially with the seven year seizure dataset (2018-2025).

Because only these years have monthly observations, making a limitation for more in depth analysis for pattern changes and causality, it also underscores a broader finding: data availability in itself follows political and bureaucratic cycles (with transparency improving only after 2020, when international scrutiny of fentanyl precursor intensified).

6.2.2 Fragmentation as Empirical Evidence

The fragmentation across years, variables and agencies is not merely a technical inconvenience but a reflection of institutional disarticulation. Different agencies report seizure using inconsistent units (tablets, liters, kilograms) or omit values entirely. Similarly, import data are published though non standard spreadsheets lacking metadata on port, supplier, or declared end use.

These structural discontinuities constitute an empirical finding: Mexico's state generates data in ways that obscure rather than illuminates the fentanyl supply chain, revealing the political contestation over who defines and controls "evidence". Even opening the question if they really possess that information privately or is it just a transparency issue.

6.2.3 Empirical Signals Within the Available Window

Within the overlapping years (2021-2025), the datasets nonetheless reveal inconsistent signals:

- Imports remain extremely high after 2021, suggesting a stable and large legal inflow of relevant precursors.
- Seizures show a reorganization around 2024, coinciding with the political transition to President Sheinbaum's administration and an apparent increase in smaller, more frequent operations.
- Quantitatively, even the largest seizure (tens of tons) represents less than 5% of plausible diversion scenarios under conservative assumptions.

These findings confirm that upstream availability vastly exceeds downstream interception capacity, an asymmetry fundamental to understanding the fentanyl economy's resilience.

6.3 Data Gaps as Diagnostic Findings

The process of building the datasets exposed several concrete absences that explain why precise or causal claims remain elusive.

Missing dimension	Manifestation in the datasets	Analytical consequence	Potential remedy
Pre 2021 import data	No accessible records before 2021	Prevents baseline trend or long term correlation with seizures	Use UN Comtrade "mirror statistics" partner export data) or request SAT customs archives
Spatial identifiers	Imports lack port or state; seizures inconsistent by municipality	Blocks spatial regression or route mapping	Access customs manifests or port authorities summaries
Purity and chemical identity	Seizures report weight, not purity	Cannot standardise to pure fentanyl equivalent mass	Laboratory data from FGR or DEA joint reports
Institutional attribution	Joint operations reported inconsistently	Obscure agency effectiveness	Create inter agency operation registry
Economic and industrial context	Imports not linked to licensed industrial consumers	Cannot separate legal vs. illicit demand	Access COFEPRIS industrial licensing data or anonymized private registries
HS code specificity	HS codes are not specific for the precursor chemical of interest	Obscure value linked to the chemical	Requesting INEGI to provide specific chemical import value

Recognising these absences is part of answering the research question: integration requires not only combining what exists but also mapping what does not.

6.4 Methodological Implications

6.4.1 Integration as Governance Mirror

There is a need to manually rebuild and align data from disparate agencies, this demonstrates that data fragmentation mirrors institutional fragmentation. Each gap (temporal, spatial or categorical) signals the boundary between bureaucratic jurisdictions. Therefore, the act of integration functions as a diagnostic tool for governance: where integration fails, coordination in enforcement likely fails as well.

6.4.2 Transparency Through Documentation

By preserving original source uncertainty (for example: missing values, inconsistent formats) rather than fixing it, the datasets make uncertainty measurable. This approach aligns with critical data studies (Latour, 2010; Poorthuis, 2021) that emphasize transparency and traceability over false precision.

6.4.3 Beyond Completeness

In politically contested fields, completeness is neither achievable nor necessary. What matters is the creation of relational consistency in data structures that allow heterogeneous observations to speak to one another. This research paper demonstrates that even minimal harmonization (year, form, mass, agency) can produce meaningful descriptive insight without privileged institutional access.

6.5 What is Needed for Higher Order Analysis

To advance from descriptive integration to inferential modelling or policy evaluation, several structural improvements are required:

1. **Temporal resolution:** Monthly or quarterly data to enable time series or lagged effect regression models.
2. **Standardized measurement units:** All substances expressed in pure kilograms equivalents to allow comparisons across forms (power, pills, liquids).
3. **Policy variables:** Explicit coding of major policy or bilateral events to test for policy impacts.

4. **Economic covariates:** Data on industrial production, pharmaceutical output, and exchange rates to control for legal demand fluctuations.
5. **Spatial detail:** Port or state level identifiers for spatial econometrics and network analysis.

With these elements, models could estimate whether changes in precursor imports predict subsequent seizures, or whether seizure intensity reduces future import volumes (allowing causal rather than descriptive claims).

6.6 Strategies for Filling Information Gaps

a) With government collaboration

- Inter-agency data integration: a shared digital registry linking COFEPRIS import licenses, SAT customs data and FGR or SEDENA seizure reports.
- Access under confidentiality protocols: universities could serve as an external custody for anonymous, policy relevant datasets.
- Routine publication schedules: periodic data releases in standardised formats would prevent the need for a reconstruction or unification.

b) Without government collaboration

When political or bureaucratic barriers persist, researchers can still advance measurement through:

- Mirror trade analysis using partner country export statistics (UN Comtrade, ITC Trade Map).
- Open-source maritime tracking to identify high volume shipments of chemical precursors.
- Judicial and media datasets of lab dismantling to approximate geographic production intensity.
- Machine learning anomaly detection on public available customs records to infer likely diversions using software or AI.

These strategies have their own limitations and implementing them correctly are above the scope of this research paper and require technical and time capacities beyond a single master student resources, this methodological answers to state opacity require governance involvement, a research team or more advanced techniques.

6.7 From Data Improvement to Policy Intelligence

Improving data quality is not merely a research goal but a policy need. Transparent, coherent datasets would allow Mexico to:

1. Detect precursor diversion early, reducing dependence on downstream seizures.
2. Quantify enforcement efficiency, distinguishing operational success from repairing artefacts.
3. Collaborative internationally through verifiable metrics rather than political rhetoric.

By making data integration itself a form of policy intelligence, Mexico could move from reactive enforcement toward proactive regulation to chemical flows.

In conclusion, the findings of this research paper confirm that the limitations of Mexico's fentanyl data can be transformed into analytical leverage with an improved methodological design. The integration of seizure and import data demonstrates that even partial information, when structured coherently, leaves valuable insight into trafficking dynamics and state capacity.

7. Conclusions

7.1 Epilogue: Tracing Clarity Through Fragments

This research began with a question that was at once technical and political: "How can fragmentary and politically contested data be systematically integrated to measure the dynamics of fentanyl trafficking in Mexico?"

At the start, this research began as a willingness to contribute to my country in what I felt were false accusations and an attempt to subordinate the government in applying the United State's will to fight our problems, which obviously sounds problematic and colonial. Nevertheless, the first part of the journey also meant a reflection on what it means to seek for facts or the truth in a landscape mined with interests, power and silence.

After requesting the data from the agencies of the Mexican government, the outcome was unexpected. Both SEDENA and COFEPRIS declared themselves incompetent to respond, despite being legally obliged to extend that information. The absence of answers was disappointing, but it clarified that the problem relied more on the way information itself is managed, fragmented, and kept.

That realization transformed the research paper. What began as a policy analysis with the use of an econometric model became a methodological exploration of how to build knowledge from incomplete sources. Unable to access official datasets, I assembled two of my own: one on fentanyl seizures (2018-2025) and another in precursor imports (2021-2025). In searching for solutions to a data shortcome, I uncovered the problem itself: the fragmentation of institutional information surrounding fentanyl in Mexico.

Working with these fragments revealed important patterns. The seizure data showed stable trafficking routes and changes in enforcement strategy, while the import data exposed the scale of chemical inflows that remain largely beyond control. Even conservative estimates suggest that current enforcement captures only a small portion of what potentially enters the illicit market. More importantly, the integration of both datasets showed that scarcity does not prevent analysis, but it shapes what kind of analysis is feasible, and what it can reveal about the State itself.

Together, the two datasets show a structural mismatch: while legal precursor imports reach millions of kilograms, seizures capture only a fraction of potential diversion. Even with conservative estimates, interdiction remains quantitatively insufficient to constrain supply.

The research question was answered through the design, construction, and integration of these two empirical sources. The process demonstrated that systematic integration is possible when three methodological principles are applied:

1. **Standardization:** imposing consistent categories (year, state, form, weight, agency) allows heterogeneous data to be merged.
2. **Transparency:** documenting missing or uncertain information turns opacity into a measurable variable
3. **Rational analysis:** instead of seeking completeness, value arises from connecting fragments across institutions to reveal proportions and asymmetries.

By following these principles, the research paper achieved a coherent representation of fentanyl dynamics despite the absence of official datasets. In consequence, the research question is answered affirmatively: integration is not feasible, but also essential for making sense of fragmented state information.

7.2 Contribution and Policy Relevance

The main contribution of this research paper lies in its methodological framework, a replicable model for producing analytical visibility in opaque policy environments. It shows that even under data scarcity, researchers can reconstruct partial but valid systems of measurement capable of identifying enforcement patterns, institutional gaps, and structural weaknesses in regulation.

For public policy, this has direct implications:

- Mexico cannot evaluate its fentanyl strategy through seizures alone, it must link enforcement data with import and licensing records to create a unified monitoring system.
- A cross-agency data platform connecting COFEPRIS, SAT and FGR would allow real time tracing of precursors movements, turning transparency into a preventive tool rather than a reactive one.
- Internationally, the methodological framework developed here can serve as a reference for data cooperation under the U.S.-Mexico bilateral agenda, demonstrating that technical integration can coexist with sovereignty and transparency.

For future research, the thesis provides the analytical foundation to move from descriptive integration towards causal analysis. With higher temporal resolution, quantities adjusted by purity, and policy variables, subsequent studies could estimate the relationship between import trends, enforcement activity and policy interventions, offering a clearer picture of how the fentanyl economy responds to state action.

7.3 Closing Reflection

Finally, this research paper is both an analytical exercise and a reflection on governance. It shows that Mexico's fentanyl crisis is not only a problem of production or enforcement, but mostly a problem of information management. This state cannot regulate what it does not measure, and it cannot measure what it chooses not to discuss.

Also, by treating data as fragments to be integrated to be truths, it is possible to produce knowledge that is both transparent and useful. The journey that started with unanswered requests for information concludes with a modest meaningful certainty: clarity does not depend on completeness, but on coherence. By confronting fragmentation directly, this research paper

contributes by providing a method to see through it, transforming scattered evidence into the foundation for more informed and accountable policymaking.

Appendix.

1.0 Table of Seizure dataset (100 observations)

Date	State	Agency	Form	Quantity (kg)	Tentative attributed group
7/02/2018	Colima	SEMAR	Precursor	49.844	Unknown
31/03/2018	Baja California	Federal Police	Pills	0.09	Sinaloa Cartel
25/05/2018	Baja California	Federal Police	Ampoules	1.8	Sinaloa Cartel
8/07/2018	Baja California	Federal Police	Pills	1.8	Sinaloa Cartel
19/07/2018	Baja California	Federal Police	Pills	0.03	Sinaloa Cartel
27/09/2018	Baja California	Federal Police	Pills	2.361	Sinaloa Cartel
25/02/2019	Sonora	SEDENA	Pills	0.9	Sinaloa Cartel
14/03/2019	Mexico City	SSPC	Pills	0.075	Unknown
30/03/2019	Baja California	SEDENA	Pills	0.075	Sinaloa Cartel
15/04/2019	Mexico City	SSPC	Powder	0.89	Unknown
17/04/2019	Sinaloa	FGR	Pills	11.533	Sinaloa Cartel
16/05/2019	Baja California	SEDENA	Pills	0.0888	Sinaloa Cartel
17/05/2019	Mexico City	SEMAR	Precursor	0.715	Unknown
24/05/2019	Sinaloa	SSPC	Pills	0.015	Sinaloa Cartel
28/05/2019	Sinaloa	FGR	Pills	3.84	Sinaloa Cartel

Date	Location	Agency	Type	Amount	Cartel
5/06/2019	Mexico City	SEMAR	Precursor	13.31	Unknown
19/06/2019	Mexico City	SEMAR	Precursor	3.09	Unknown
23/06/2019	Sinaloa	Federal Police	Pills	0.66	Sinaloa Cartel
28/06/2019	Guadalajara	SEMAR	Precursor	0.224	Unknown
19/07/2019	Mexico City	SEMAR	Precursor	3.095	Unknown
10/08/2019	Sonora	SEDENA	Pills	0.57	Sinaloa Cartel
31/08/2019	Baja California Sur	SEDENA	Powder	12.9	Sinaloa Cartel
2/09/2019	Mexico City	SSPC	Pills	0.1461	Unknown
5/10/2019	Baja California Sur	SEDENA	Powder	1	Sinaloa Cartel
13/11/2019	Jalisco	Guardia Nacional	Pills	0.27	Cartel Jalisco New Generation
6/12/2019	Sonora	SEDENA	Pills	0.66	Sinaloa Cartel
14/12/2019	Sonora	SEDENA	Pills	3475	Sinaloa Cartel
18/12/2019	Baja California	SEDENA	Ampoules	1.31	Sinaloa Cartel
13/01/2020	Sinaloa	Guardia Nacional	Pills	0.024	Sinaloa Cartel
23/02/2020	Sinaloa	Guardia Nacional	Pills	0.234	Sinaloa Cartel
7/04/2020	Mexico City	Guardia Nacional	Powder	49	Unknown
6/05/2020	Chihuahua	Guardia Nacional	Pills	0.39	Unknown
13/05/2020	Mexico City	Guardia Nacional	Ampoules	0.6	Unknown
22/05/2020	Baja California	SEMAR	Precursor	69.169	Unknown

3/06/2020	Mexico City	Guardia Nacional	Pills	0.3	Unknown
17/07/2020	Chihuahua	Guardia Nacional	Pills	0.075	Sinaloa Cartel
16/08/2020	Chihuahua	Guardia Nacional	Pills	0.0591	Sinaloa Cartel
2/09/2020	Querétaro	Guardia Nacional	Ampoules	3.66	Unknown
20/09/2020	Mexico City	Guardia Nacional	Powder	7.5	Unknown
7/10/2020	Nuevo León	Guardia Nacional	Pills	0.285	Sinaloa Cartel
22/10/2020	Mexico City	Guardia Nacional	Pills	0.6	Unknown
2/12/2020	Guadalajara	SEMAR	Precursor	55	Unknown
16/12/2020	Puebla	SEDENA	Powder	42	Cartel Jalisco New Generation
31/12/2020	Querétaro	Guardia Nacional	Ampoules	13	Unknown
24/04/2021	Mexico City	SEMAR	Precursor	3	Unknown
7/05/2021	Sinaloa	FGR	Powder	17.9637	Sinaloa Cartel
13/06/2021	Mexico City	Guardia Nacional	Powder	23	Unknown
2/09/2021	Baja California	Guardia Nacional	Pills	19.5	Sinaloa Cartel
13/09/2021	Querétaro	Guardia Nacional	Ampoules	1.8	Sinaloa Cartel
29/09/2021	Guadalajara	SEMAR	Precursor	28.032	Unknown
23/10/2021	Sonora	Guardia Nacional	Pills	0.9	Sinaloa Cartel
4/11/2021	Sinaloa	SEDENA	Paste	118	Sinaloa Cartel
22/11/2021	Tijuana	SEMAR	Precursor	25	Unknown
11/12/2021	Querétaro	Guardia	Ampoules	2.5	Gulf Cartel

		Nacional			
28/01/2022	Tijuana	SEMAR	Precursor	1.146	Unknown
24/05/2022	Baja California	FGR	Powder	93	Sinaloa Cartel
30/06/2022	Colima	SEMAR	Precursor	16770	Cartel Jalisco New Generation
1/07/2022	Manzanillo	SEMAR	Precursor	16.76	Unknown
7/07/2022	Sinaloa	Federal Police	Powder	542.72	Sinaloa Cartel
29/07/2022	Mexico City	SEMAR	Precursor	4	Unknown
27/09/2022	Mexico City	SEMAR	Precursor	7.424	Unknown
24/10/2022	Sonora	SEDENA	Powder	34.16	Sinaloa Cartel
4/11/2022	Tijuana	SEMAR	Precursor	2.028	Unknown
14/02/2023	Sinaloa	SEDENA	Pills	317.04	Sinaloa Cartel
16/02/2023	Campeche	State Police	Pills	188.7	Gulf Cartel
26/02/2023	Durango	FGR	Pills	1.11	Sinaloa Cartel
15/03/2023	Aguascalientes	SEDENA	Pills	0.1095	Cartel Jalisco New Generation
6/04/2023	Baja California	SEDENA	Pills	44	Sinaloa Cartel
8/04/2023	Sinaloa	SEDENA	Pills	123113	Sinaloa Cartel
4/05/2023	Aguascalientes	SEDENA	Powder	0.24	Cartel Jalisco New Generation
8/05/2023	Sonora	State Police	Pills	0.0567	Sinaloa Cartel
24/06/2023	Chihuahua	Federal Police	Pills	12	Sinaloa Cartel
29/07/2023	Baja California	Guardia Nacional	Pills	Null	Sinaloa Cartel

Date	State	Agency	Type	Amount	Cartel
2/10/2023	Baja California	FGR	Pills	91.8	Sinaloa Cartel
6/10/2023	Baja California	FGR	Pills	90	Sinaloa Cartel
27/03/2024	Sinaloa	FGR	Precursor	7769	Sinaloa Cartel
11/08/2024	Baja California	SEDENA	Pills	8.5	Sinaloa Cartel
27/08/2024	Baja California	Guardia Nacional	Pills	1.5	Sinaloa Cartel
3/12/2024	Sinaloa	SSPC	Pills	1100	Sinaloa Cartel
3/12/2024	Sinaloa	SSPC	Pills	2	Sinaloa Cartel
29/12/2024	Colima	SEMAR	Precursor	25000	Cartel Jalisco New Generation
1/01/2025	Mexico City	FGR	Pills	2.9937	Unknown
1/01/2025	Sonora	SEDENA	Pills	18	Sinaloa Cartel
10/03/2025	Sinaloa	SSPC	Pills	79.8	Sinaloa Cartel
12/03/2025	Querétaro	SEDENA	Pills	26	Unknown
14/03/2025	Sonora	State Police	Pills	45	Sinaloa Cartel
21/03/2025	Zacatecas	Guardia Nacional	Precursor	10950	Sinaloa Cartel
3/04/2025	Sonora	SEDENA	Unknown	33	Sinaloa Cartel
7/04/2025	Sonora	State Police	Pills	90	Sinaloa Cartel
23/04/2025	Sinaloa	SSPC	Pills	0.3114	Sinaloa Cartel
23/04/2025	Sonora	SSPC	Pills	0.2511	Sinaloa Cartel
12/05/2025	Baja	FGR	Pills	3334.9248	Sinaloa

	California				Cartel
13/05/2025	Sonora	Guardia Nacional	Pills	0.297	Sinaloa Cartel
30/05/2025	Tamaulipas	State Police	Pills	1	Sinaloa Cartel
18/07/2025	Chihuahua	Guardia Nacional	Pills	3.0549	Sinaloa Cartel
20/07/2025	Chihuahua	Guardia Nacional	Pills	1.8	Sinaloa Cartel
1/09/2025	Sonora	SEDENA	Pills	52	Sinaloa Cartel
1/09/2025	Sonora	Federal Police	Pills	19	Sinaloa Cartel
1/09/2025	Sonora	Federal Police	Pills	33	Sinaloa Cartel
7/10/2025	Mexico City	FGR	Pills	30.9957	Unknown

2.0 Methodological script of the Seizures Dataset (2018-2025)

Construction of the National Dataset on Fentanyl Seizures in Mexico (2018–2025)

Defining the Empirical Universe

To construct a credible national dataset on fentanyl seizures from publicly available information calls for several choices. In my case, I sought to define a universe that would be broad enough to include the many guises and formats in which fentanyl appears, but narrow enough to maintain precision and analytical coherence.

I defined the empirical universe of observations using five main parameters:

- **Substance**: The seizure must involve fentanyl itself, one of its analogues (e.g., carfentanil), or a precursor chemical directly usable in its synthesis (e.g., ANPP, NPP). Events involving opioids generically, without explicit fentanyl reference, were excluded.

- **Territory**: The seizure must have occurred on Mexican soil, including border crossings, maritime ports, highways, or laboratories, and must have been conducted by Mexican authorities (military, federal, state, or municipal).

- **Time Frame**: January 1, 2018 to October 31, 2025[AB1] J.

- **Scale**: No threshold was applied. A seizure of one vial or a micro-package was treated with the same methodological care as multi-kilogram seizures.

- **Verifiability**: Each observation had to be traceable to at least one identifiable source (official document, news article, press release) with date and geographic reference.

These parameters aligned with the key, that is, to produce the most complete and traceable national dataset of fentanyl seizures possible using open sources.

Initial Construction: Manual Retrieval and Translation

The first iteration of the dataset was constructed using Python code that searched across the internet based on different key words to find the different observations of the defined universe. For example: Fentanyl + 2018 + Baja California with the substance (fentanyl and its main precursors, the year (from 2018 to 2025) and the state of interest (the 32 Mexican States were included in the coding). The code included sources that were catalogued as official (government portals) and local media in case the report was not found in the previous source, taking into account the following sites:

Official Government Portals

We began with systematic searches on the portals of:

- Secretaría de la Defensa Nacional (SEDENA)

- Guardia Nacional (GN)

- Secretaría de Seguridad y Protección Ciudadana (SSPC)

- Fiscalía General de la República (FGR)

These portals provide *boletines de prensa* (press releases) in HTML or PDF format. They are not searchable via internal filters, so I used Google with advanced operators:

- site:sedena.gob.mx fentanilo decomiso
- site:sspc.gob.mx fentanilo aseguramiento

Each entry was reviewed for:

- Date of publication and seizure

- Location (state, municipality, checkpoint)

- Description of form: pills, powder, liquid, ampoules

- Weight or count (pills, kg, liters)

- Whether the event was unique or part of a multi-site operation

If the unit of measure was pills, I applied a metric of **0.3g = 1 pill** to produce a standardized kg estimate (Std_Quantity_Kg). In terms of price, I used **1 pill= 5 USD** (Rand, 2021) as an average of the price for each pill that could be sold.

Where only volume was given (e.g., liters), the case was retained but not standardized unless a conversion factor was stated. If seizures involved several substances (e.g., fentanyl and methamphetamine), only the fentanyl data was extracted.

Major Media Outlets

After exhausting official sources, we queried national media archives:

- El Universal

- Milenio

- La Jornada

- Zeta Tijuana (notably detailed on border seizures)

Searches were conducted using keywords:

- fentanilo asegurado site:eluniversal.com.mx

- decomiso de fentanilo año:2019 site:milenio.com

All media entries were scanned to ensure they were not reproducing official bulletins. Entries that included:

- Names of arresting authorities,

- Unique location details,

- Photos of packages or operational footage,

were retained. Others were discarded if they duplicated official announcements without adding new data.

At this stage, entries were tagged as:

- Source_Category: "Official" or "Media"
- Data_Confidence: "High" (official with numeric data), "Medium" (press with location/date), "Low" (unclear source or no quantity)

By the end of this wave, 41 unique observations were located and information was harvested.

The Batch Expansion Method: "Batches"

It was evident that the initial dataset overrepresented certain states (e.g., Sonora, Baja California) and recent years (2022–2023). To correct this, I developed a batch-based strategy: each batch would target a specific time range, state, or data gap.

Example Batch: 2018–2019

We began by isolating 2018–2019, which was underrepresented. Using queries like:

- fentanilo aseguramiento 2018 site:proceso.com.mx

- fentanilo SEDENA 2019 site:gn.gob.mx

This batch yielded 9 new observations, several from media sources covering Sinaloa and Durango.

Example Batch: Underrepresented States

States with zero entries (e.g., Zacatecas, Campeche) were each assigned a search plan. Search terms included:

- primer decomiso de fentanilo en [state name]
- fentanilo asegurado en [municipality]

In Zacatecas, I found one record of a micro-seizure (12 pills, 2022). In Campeche, no confirmed fentanyl seizure was found, but this absence was triangulated with statements from state police saying fentanyl had not been observed yet.

Each batch concluded with:

- De-duplication check[AB2] (removing duplicates)

- Inclusion test (does it meet universe criteria?)

- Documentation of the search queries and rejected items

By the end of batch testing, the dataset had 59 observations.

Comprehensive Saturation Audit

After consolidating batch findings, I initiated a saturation audit to empirically test whether further data existed. This process is critical in inductive research where completeness cannot be taken for granted.

Framework for Saturation

Following qualitative saturation theory (Guest et al., 2006; Saunders et al., 2018), we defined empirical saturation as:

> "The point at which new rounds of data collection no longer produce additional units of analysis."

I applied this definition operationally:

- All 32 states were scanned again using a uniform query template

- The search was run across three rounds per state

- A hit was counted only if a new seizure, not already in the dataset, was found

If two consecutive rounds for a state yielded no new records, I flagged it as saturated[AB3] .

Search Implementation

For each state, we searched:

- fentanilo decomiso site:.mx [state name]

- fentanilo asegurado site:facebook.com [local police]

- "fentanilo" + "Secretaría de Seguridad" + [municipality]

Each result was reviewed. Valid new records were coded and added. In states like Guerrero, we identified micro-events not covered in national media.

Outcome

By late 2025, saturation was confirmed:

- 67 total unique observations

- At least one record per state

- Many states (Tlaxcala, Querétaro) had a single entry

Integration of Precursor Seizures (2025)

Separately, I filed a transparency request (number 342746500023825) to the **Agencia Nacional de Aduanas de México (ANAM)**. The information obtained (Excel annex) contained 83 precursor-related seizures.

Filtering criteria:

- Substance must appear in fentanyl synthesis pathways (UNODC, 2022)

- Seizure must be on Mexican soil

- Authority must be Mexican (not U.S. CBP)

These were labeled with Evidence_Type_Detail = Precursor and Source_Category = Official.

Final Structure and Coding

The final master sheet included:

- Date

- State_or_Entity_EN

- Location_Details

- Std_Quantity_Kg

- Seizure_Details_EN

- Group_Attributed

- Estimated_Value_USD

- Pills_Approx

- Source_Category

- Harvard_Citation

- URL

Estimated value was calculated at USD 30,000 per kg and USD 5 per pill (RAND, 2021).

Each entry was formatted in English to align with the thesis's linguistic register.

Since the dataset was compiled with the use of AI and the python code, manual cleaning of the dataset was conducted to remove potential duplicates or errors in data capturing. The final dataset contained 69 observations prior to the inclusion of the observations provided by ANAM.

With the inclusion of the precursor chemical observations provided by ANAM the dataset included 86 unique and ascertainable observations.

For robustness checks and to finalize the exhaustivity tests, another 3 rounds of searches were coded in order to find observations now including precursor cases in sources across the media, differentiated in 3 batches of different years. This exercise led to the inclusion of 21 potential observations. After reviewing criteria filters and duplication analysis, 14 observations were added to the 86 which led to a seizure dataset with 100 complete observations.

Through a meticulous, iterative, and empirically transparent approach, the database represents not merely a collection of seizures, but demonstrates that public data, when exhaustively mined, cross-referenced, and filtered with care, can yield high-value intelligence on clandestine phenomena. While no database is exhaustive, arguably, the data set collected for this paper is perhaps the most complete retrievable documentary record of fentanyl seizures in Mexico over the period 2018–2025.

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