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Combating Information Disorder in Healthcare: A Vaccine Supply Chain Case

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ABSTRACT

The COVID-19 vaccine supply chain faced unprecedented disruption from information disorder (collectively, misinformation, disinformation, and malinformation (MDM)). While prior research has examined the societal and health consequences of information disorder, little is known about how it disrupts supply chain management (SCM) or how supply chain actors respond. Guided by organizational information processing theory (OIPT) and stakeholder theory (ST), this study employs an embedded qualitative case study of the U.S. COVID-19 vaccine supply chain. We find that crisis-induced MDM functioned as an exogenous shock that heightened uncertainty and equivocality, overwhelming information-processing capacity, and fragmenting stakeholder responsibility. Downstream actors (i.e., pharmacies and clinicians) were disproportionately burdened in their efforts to combat MDM, relying largely on reactive tactics. Additionally, SC actors prioritized correcting false claims while deferring attribution of intent. This led to the conflation of misinformation and disinformation and the underdiagnosis of malinformation. By integrating OIPT and ST, we develop a framework that explains how information-processing misfit and shifting stakeholder salience jointly produce operational disruption and uneven accountability. Our findings extend SCM theory by conceptualizing MDM as a systemic supply chain risk and offer actionable guidance to improve resilience and trust.

1 | Introduction

The COVID-19 vaccine was synthesized within 12 months of the pathogen's identification (Cohen 2020). Since then, over 676 million doses have been administered in the U.S. (Mathieu et al. 2024). This mobilization harnessed best-in-class supply chain management (SCM).¹ Manufacturers such as Pfizer, Moderna, and Johnson & Johnson, collaborating with raw material suppliers, logistics providers, and government agencies, orchestrated sourcing, developed new formulations, and mass-produced and distributed vaccines (Bown and Bollyky 2022). The declared public health emergency (PHE) also led to heightened federal oversight from agencies such as the Centers for Disease Control and Prevention (CDC) and the Department of

Health and Human Services (HHS), as well as state and local health departments (Clowers 2021).

Despite this mobilization, the vaccine rollout unfolded within a broader environment of information disorder, comprising misinformation (false information shared without intent to harm), disinformation (false information shared with intent to harm), and malinformation (accurate information used to cause harm) (Dubois et al. 2025; Wardle and Derakhshan 2017). We refer to these three forms as MDM, which undermined efforts to achieve herd immunity during the pandemic. Examples are numerous. Baseless conspiracy theories (i.e., debunked claims that 5G towers interact with vaccines or that vaccines alter a recipient's DNA) fueled public

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skepticism (Tao et al. 2023; Wu 2020). Politicians and cultural figures amplified misleading messages, while public health campaigns were branded as biased (Bolsen and Palm 2022). The “Disinformation Dozen,” responsible for 65% of anti-vaccine misinformation on social media, reveals how just a handful of influencers can drive widespread distrust in contemporary information ecosystems (Bond 2021). Research demonstrates that, although vaccine hesitancy stems from myriad factors, the pervasive spread of MDM has exacerbated it (Hansson et al. 2021; Wiysonge et al. 2022).² Ultimately, MDM decreases vaccination intent (Turner et al. 2021).

Beyond public health challenges, MDM also disrupts SCs. It has been tied to panic buying, hoarding, and demand surges that strain production, logistics, and labor (e.g., Kar et al. 2023; Aljanabi 2023). In this respect, MDM-driven disturbances share conceptual overlap with the classic bullwhip effect. Lee et al. (1997) show how distorted demand signals can amplify variability through the SC. For example, in the vaccine SC, MDM alters downstream perceptions of demand via uncertainty surrounding vaccine safety. As a result, it contaminates information signals that SC actors use for planning and allocation. However, unlike classic bullwhip examples, MDM enters SCs exogenously and simultaneously at multiple nodes. While research has begun to examine misinformation in SCs (e.g., Akhtar et al. 2023; Kar et al. 2023; Sarraf et al. 2024), scant attention has been given to the broader concept of MDM despite its widespread impact. A focus on misinformation alone is too narrow. MDM’s three dimensions (misinformation, disinformation, and malinformation) are distinguished by veracity and intent to harm (Wardle and Derakhshan 2017). Because all three circulated during the pandemic, the full MDM construct is required to capture SC-relevant disruptions.

Our study is motivated by concerns raised by researchers (e.g., Damasceno 2021), policymakers (e.g., Scott and Lerman 2021), and healthcare SC executives (e.g., Barnhill 2021) about the operational consequences of MDM and the need for coordinated responses. For example, see a recent back-and-forth between the federal government and the state of Florida over vaccine distribution (O’Brien 2021). Examples such as these suggest that “who is responsible” can often be unclear or contested.

To better understand how SC actors can identify and mitigate the effects of MDM, we draw on two complementary theoretical lenses. First, organizational information processing theory (OIPT) explains how organizations (and SCs, more broadly) sustain performance by improving their information-processing capacity as uncertainty and equivocality increase (Galbraith 1974). This happens in two ways: firms can either reduce their incoming information needs by standardizing/filtering input data, or they can increase their processing capacity by adopting richer coordination mechanisms (Srinivasan and Swink 2015, 2018). During COVID-19, MDM strained the vaccine SC’s information-processing capacity. Uncertainty surfaced in conflicting supply data, shifting guidance, and gaps in tracking. Equivocality stemmed from competing narratives about vaccine safety, efficacy, and rollout rules. For instance, healthcare workers navigated both uncertainty and equivocality as they tried to interpret conflicting messages to determine vaccination priorities during early waves of the vaccine rollout (Emanuel 2020).

Separately, stakeholder theory (ST) emphasizes that firms should consider the interests of all actors affected by, or with the potential to affect, their operations (Freeman 2010; Mahajan et al. 2023). A stakeholder’s salience is shaped by power, legitimacy, and urgency (PLU) (Mitchell et al. 1997). These attributes can shift dynamically under crisis conditions: urgency spikes, legitimacy becomes contested, and power redistributes as the influence of new actors changes (Co and Barro 2009; Kovács 2022). In the COVID-19 vaccine SC, MDM affected PLU by amplifying power asymmetries and minimizing the concerns of less-visible stakeholders. We draw on Adekola and Chia’s (2024) articulation of “epistemic injustice.” From an ST perspective, epistemic injustice highlights a distortion in PLU that alters which stakeholders’ claims are recognized as legitimate, urgent, or actionable. ST has been applied in SCM to understand collaboration, risk governance, and sustainability (Co and Barro 2009; Kovács 2022). However, it has not yet been brought together with OIPT to explain how crisis-induced MDM reshapes stakeholder salience or redistributes responsibility for combating it across SC tiers. This dual-theoretical approach provides a richer picture of MDM through the lens of SCM.

As noted, critical gaps remain in understanding how SC actors navigate information-related disruptions and allocate responsibility for mitigation. MDM is not relegated to a single node in the SC. It spreads across tiers, increasing uncertainty and equivocality through the entire ecosystem. Thus, in MDM-affected SCs, collaboration requires clarity regarding which actors are responsible for detecting and mitigating MDM. Research is needed to clarify how SC actors delineate responsibility. The current gap is significant, given evidence that firm collaboration mitigates SC risk (Zhou and Benton Jr 2007). To address this, we employ a single embedded case study (e.g., Yin 2009) of MDM in the COVID-19 vaccine SC. Specifically, we investigate:

- RQ1: How do the impacts from information disorder manifest within the vaccine supply chain?
- RQ2: What strategies do supply chain actors adopt to combat information disorder?
- RQ3: Do actors within the supply chain perceive differing levels of responsibility for combating information disorder?

Our qualitative research design incorporates academic literature, news media, archival materials, and in-depth interviews with expert decision makers directly involved in the vaccine SC (Eisenhardt 1989; Yin 2009). In doing so, we respond to a call to action from Damasceno (2021), who argues that research has thus far failed “to address the central question of how to deal with fast-paced changes that surround the information disorder phenomenon” (2). We find that crisis-induced MDM within the COVID-19 vaccine SC disrupted operational efficiency, public trust, and vaccine uptake through inadequate information-processing capacity. Stakeholder salience reconfigured unevenly during the crisis, producing fragmented mitigation efforts and an uneven distribution of responsibility across tiers. Downstream entities bore the heaviest burden, as urgency dominated early and legitimacy increasingly migrated toward consumer-facing nodes. Under high urgency, actors prioritized correcting false claims while deferring attribution of intent. This led to conflating misinformation and disinformation and

the underdiagnosis of malinformation. Although some coalition building did occur across SC nodes, a more common pattern was firm-specific, siloed tactics, such as FAQs, prebunking, and targeted messaging.

Our study contributes to both theory and practice by positioning MDM as a systemic risk to SCs. This study expands the typical representation of the vaccine SC to include more decision-making nodes than are typically represented in prior literature (e.g., Georgiadis and Georgiadis 2021; Golan et al. 2021). Having a more robust understanding of this complex landscape provides new insights into how/why stakeholder salience becomes difficult to assess during urgent crisis conditions. Drawing on OIPT and ST, we demonstrate how crisis-induced shocks simultaneously overwhelm information-processing capacity and reconfigure stakeholder salience. Traditionally, OIPT explains performance as a function of task complexity (Srinivasan and Swink 2018). Here, we extend it to show that uncertainty and equivocality can be induced through MDM. Likewise, we extend ST by demonstrating how crisis-induced MDM reshapes stakeholder salience (i.e., PLU) through information asymmetries and epistemic injustice (Adekola and Chia 2024). OIPT and ST jointly create a novel, unified lens that explains why MDM impacts occur and why responsibility fragments.

Practically, we underscore the need for shared accountability mechanisms that redistribute information and responsibility across SC tiers. We highlight the importance of coalition building, synchronized communication, and proactive contingency planning. Additionally, we identify a toolkit of low-tech, human-centered tactics. Our results suggest that resilience depends on blending human expertise, collaborative governance, enhanced information-processing capacity, and clarified stakeholder salience to sustain trust and performance during crises. Accordingly, practitioners can operationalize these insights by leveraging shared response playbooks, cross-tier communication, and low-tech mitigation strategies. We also stress the need for SCs to invest in advanced technology to support MDM mitigation, inclusive of all SC partners.

2 | Background and Literature Review

2.1 | The COVID-19 Vaccine Supply Chain

Prior research on the COVID-19 vaccine SC has primarily focused on upstream R&D and manufacturing rather than downstream administration to potentially hesitant consumers (Georgiadis and Georgiadis 2021; Golan et al. 2021). Bown and Bollyky (2022) examine product development and highlight both the significant government involvement and public investment that shaped vaccine evolution. Their work addresses challenges firms face regarding the limited availability of critical inputs. They highlight a need for multiple SCs to prevent “vaccine nationalism” and ensure more equitable global distribution. Meanwhile, Alam et al. (2021) discuss impediments to sustainably scaling up the SC, critical for pandemic mitigation. They argue that addressing network issues is essential for achieving positive SC performance outcomes and progress on the UN’s Sustainable Development Goals.

Less research considers the vaccine SC end-to-end, including clinical administration sites or the government’s unique role in issuing Emergency Use Authorization (EUA) before full FDA approval (Bown and Bollyky 2022). Vaccine manufacturers conduct research and development (R&D), source materials, and address shortages (Georgiadis and Georgiadis 2021). Logistics providers manage cold-chain transportation to ensure strict temperature controls (Lin et al. 2020). Administration sites (e.g., hospitals, pharmacies, and clinics) handle proper storage, inventory management, and vaccine delivery to consumers to ensure minimal wastage and compliance (Lazarus et al. 2022). Beyond product flow, regulatory bodies such as the FDA and CDC, as well as individual state agencies, oversee approval and distribution processes to ensure safety and efficacy (Alam et al. 2021; Kochakkashani et al. 2023).

Our study seeks to provide a more comprehensive view of this complexity, examining how different echelons coordinate (or not) when addressing MDM.

2.2 | Information Disorder in Healthcare Supply Chains

MDM has emerged as a “grand challenge” with implications for public discourse, governance, and business operations (Eisenhardt et al. 2016). Credible information flows are essential for SC coordination and performance (Ashraf, Yalcin, and Hos 2025). Wardle and Derakhshan (2017) distinguish misinformation, disinformation, and malinformation by dimensions of veracity and intent to harm. During the COVID-19 pandemic, this “infodemic” revealed how digitally amplified information disorder can destabilize healthcare SCs (Hansson et al. 2021; World Health Organization 2022). MDM disrupts the integrity of information, which is essential for SC efficiency and crisis response (Maret 2025). It contributes to operational slowdowns, panic-driven demand volatility, regulatory confusion, and vaccine hesitancy (Aljanabi 2023). These dynamics illustrate how sociopolitical forces and digital platforms can distort demand signals and erode trust across healthcare supply networks. Appendix 1 organizes nascent streams of literature on MDM.

Responses to MDM can span technological, institutional, and educational domains. In SCM scholarship, AI and machine learning now support real-time detection (Akhtar et al. 2023), blockchain strengthens transparency (Petratos and Faccia 2023), and sentiment analysis tracks consumer behavior (Cano-Marin et al. 2023). Predictive analytics and closer retailer-supplier collaboration further bolster resilience (Gupta et al. 2021). However, scholars warn that untested AI tools may inadvertently spread false/misleading information in SCs (Richey Jr et al. 2023). Traditional responses emphasize fact-checking and regulation, though efficacy hinges on enforcement and trust (Wardle and Derakhshan 2017). Educational efforts in media literacy show mixed outcomes: exposure to diverse sources can either entrench echo chambers or broaden perspectives (Damasceno 2021). Ultimately, enhancing SC agility and coordination enables firms to preempt MDM’s effects and ensure evidence-based decision-making (Kar et al. 2023).

Widespread false claims about vaccine safety prompted interventions across clinical, technological, and institutional domains. At the clinical level, practitioners have engaged in trust-building conversations to counter conspiracy theories (Perkins et al. 2023), and frontline pharmacists have developed targeted outreach initiatives (Erku et al. 2021). Debunking and prebunking efforts (Traberg et al. 2023; Wahab et al. 2023) further aim to strengthen individuals' resistance to false claims. At the technological level, platform-based content verification mechanisms have been implemented within social media (Peng et al. 2023). At the institutional level, national security strategies and public health agencies have promoted collaborative, evidence-based responses to MDM (Gisondi et al. 2022). More targeted countermeasures address emotion-driven conspiracies (Zhao et al. 2023). Despite growing attention to MDM in SCM, the literature remains fragmented. Multi-stakeholder studies (e.g., Wahab et al. 2023) do not examine how perceived responsibility varies across SC nodes. This gap is consequential, as research on SC alignment shows that a lack of strategic fit across stakeholder objectives weakens coordination and ultimately reduces performance (Skipworth et al. 2015).

To triangulate scholarly accounts of vaccine-related MDM, we conducted an exploratory review of 135 news articles (2021–2024) retrieved from LexisNexis.³ Our goal was not an exhaustive review, but to gain directional insight into how supply chain (SC) actors publicly responded to information-related disruptions. We began with the term “misinformation,” as it is the dominant label used in mainstream media coverage of COVID-19. To assess whether this choice constrained the sample, we conducted supplementary searches by replacing “misinformation” with “disinformation,” “malinformation,” and “information disorder.” These searches yielded no additional relevant articles beyond those already captured. This pattern suggests that public discourse largely consolidates distinct forms of information disorder under the broader label of misinformation. Within the resulting corpus, misinformation was frequently referenced, disinformation less often, and malinformation rarely. While this distribution is partially shaped by prevailing media terminology, it also reflects the difficulty of attributing intent in practice, as “ascertaining the intent of the propagator of information may be challenging” (UNHCR 2025).

Coverage centered largely on political figures and public health officials, while manufacturers, distributors, and logistics providers were rarely represented. The limited visibility of upstream and midstream actors in public discourse suggests fragmentation in perceived responsibility for addressing information disorder. This observation reinforces the need to examine how information-processing demands (OIPT) and stakeholder salience (ST) shape coordination and accountability across SC tiers.

Tracing how MDM moves through networks and influences decisions is essential. OIPT can explain how mismatches between information-processing requirements and capacity under uncertainty shape coordination and performance (Fang et al. 2025). ST can then clarify how actors' perceived roles, obligations, and salience determine whose concerns are prioritized and how

responsibility for mitigation is assigned (Mitchell et al. 1997). Together, they reveal both the processing of information and the distribution of accountability in a complex SC ecosystem.

2.3 | Organizational Information Processing Theory

OIPT concerns the alignment of information-processing needs with available organizational capacity (Srinivasan and Swink 2018). It explains how firms maintain performance under conditions of both uncertainty (insufficient information) and equivocality (multiple, conflicting interpretations) (Zhu et al. 2018). Seminal OIPT scholar Galbraith (1974) posits that organizations address interdependent tasks by moving from rules and programs (for predictable tasks) to hierarchical exception handling (for novel cases) and finally to coordination by goals or targets (delegating discretion), with each mechanism requiring progressively greater information processing as task complexity intensifies.

As OIPT suggests, the greater the uncertainty and/or equivocality surrounding a task, the more information must be processed among decision-makers (Galbraith 1974). If information is unable to be processed adequately by decision makers, “firms may be overwhelmed by these uncertainties and the damage they cause to performance” (Fang et al. 2025, 3). These lack-of-fit conditions parallel the modern MDM environment. Here, rapid data proliferation and limited processing capacity create information distortion. OIPT typically suggests a few pathways toward addressing poor information fit: (1) reducing information-processing needs or (2) improving information-processing capacity (Galbraith 1974). The challenge with crisis-induced MDM (i.e., COVID-19-related MDM) is that it occurs in unexpected moments of heightened panic. This prevents concerted efforts for organizations to amass across complex ecosystems (i.e., the vaccine SC) to coordinate responses.

As OIPT was imported into SCM, the unit of analysis expanded from the firm to cross-boundary relationships. Srinivasan and Swink (2018) demonstrate that cross-functional integration and planning serve as boundary-spanning mechanisms that enhance SC responsiveness. Zhu et al. (2018) relate this to the network level, modeling analytics capabilities across plan–source–make–deliver processes as chain-wide information-processing capacities. In contrast, Fang et al. (2025) apply OIPT to finance triads, linking digitalization to improved transparency and ethical conduct. Within the vaccine SC, MDM functions as a shock that amplifies uncertainty and equivocality in information flows. To OIPT, when information-processing requirements outstrip the organization's capacity, performance degrades (Galbraith 1974). This catalyzes an array of outcomes, requiring an examination of how and why partnerships confront ambiguity. For this task, we now turn to ST.

2.4 | Stakeholder Theory

Stakeholder theory (ST) extends the firm's purpose beyond shareholder primacy by emphasizing that firms (and SCs more broadly) must engage all actors who affect or are affected by their

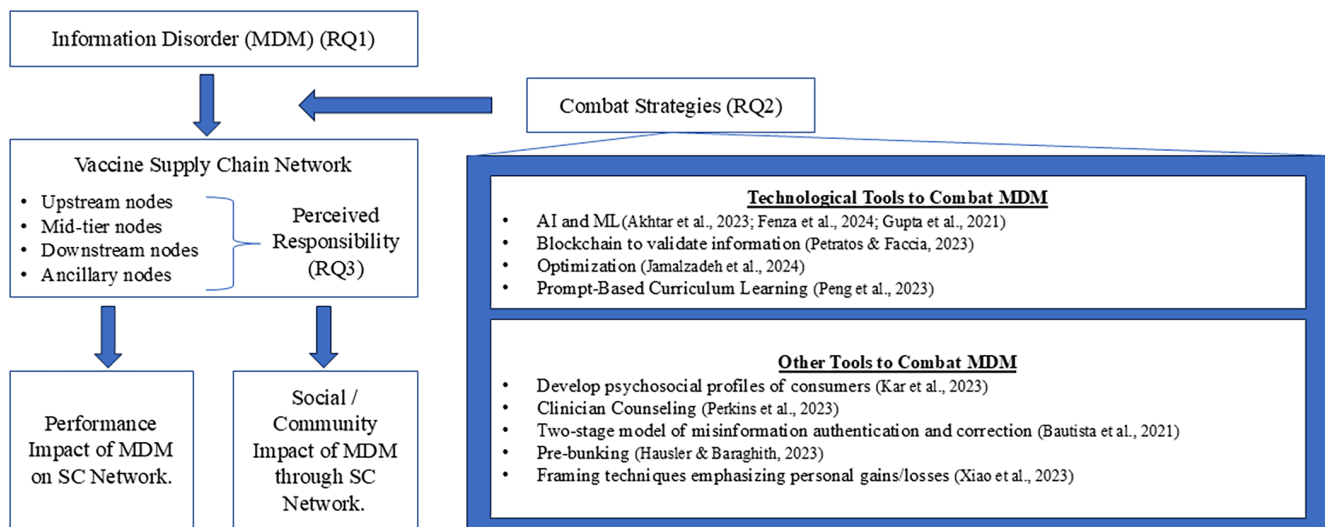


FIGURE 1 | Preliminary model for research question evaluation.

operations (Parmar et al. 2010). This expands the set of relevant stakeholders to include employees, customers, suppliers, communities, and the environment (Freeman 2010; Kovács 2022; Mitchell et al. 1997). In doing so, ST highlights broader ethical and social dimensions of business strategy. Donaldson and Preston (1995) identify three distinct but complementary conceptualizations: descriptive (explaining the corporation as a network of stakeholder interests), instrumental (linking stakeholder engagement to performance outcomes), and normative (grounding ST in moral principles). By deploying ST across all of these interpretations, our study can (a) map how vaccine SC actors actually experienced and responded to MDM, (b) trace varied mitigation strategies in response to exogenous shocks, and (c) foreground the ethical obligation to share responsibility more equitably across tiers.

Stakeholder salience is the degree of managerial attention stakeholders receive. Salience is determined by attributes of power, legitimacy, and urgency (PLU) (Mahajan et al. 2023). Power reflects access to coercive means to impose one's will; legitimacy is a judgment that actions are desirable or proper; and urgency denotes the degree to which a claim demands immediate attention (Co and Barro 2009; Mitchell et al. 1997; Suchman 1995). PLU is variable and socially constructed (Kovács 2022). Because perceptions drive salience, they must be continually reassessed as PLU conditions change. The growing complexity of global SCs makes ST particularly relevant to SCM where firms must navigate evolving relationships with a broad array of societal actors (Kovács 2022).

Urgency escalated during the COVID-19 pandemic (see the PHE declaration). This prompted swift action and reshaped legitimacy and power around regulators, public health agencies, vaccine producers, logistics partners, and communities. Effective coordination across SC nodes was crucial to accelerating vaccine availability and addressing public concerns (Adekola and Chia 2024). The pandemic also elevated the role of non-contractual stakeholders, including advocacy groups and media firms. To all of these SC actors, MDM emerged as a novel disruptor.

2.5 | Initial Research Model

Our exploratory review of news media and of extant scholarship provides a foundation for an initial research model. This model treats MDM as an exogenous shock. It catalogues potential strategies to combat MDM and outlines its outcomes in the SC. MDM flows into the vaccine SC and spreads across nodes (RQ1). Both technological (i.e., AI/ML, blockchain, optimization, curriculum learning) and psychosocial (i.e., consumer profiling, counseling, prebunking, framing) tools can be mobilized to mitigate and contain their disruptive effects (RQ2). These dynamics align with OIPT, where information overload strains processing capacity by heightening uncertainty and equivocality. Within the vaccine SC, an open question remains about who perceives responsibility for intervention at each tier (RQ3). ST suggests that the PLU of actors becomes fluid and contested under crisis conditions. Our model (Figure 1) illustrates these dynamics. From here, the case study is an appropriate methodological approach for data collection (Yin 2009) to both validate and extend our conceptual model.

3 | Methodology

Qualitative research delves into the intricacies of “how” and “why” questions (Yin 2009). Case studies provide a means to examine unique contexts and uncover underlying mechanisms. In SCM research, they enable in-depth exploration of complex, real-world phenomena, offer design flexibility, and support analytic generalization (e.g., Seuring 2008). Our research goals require unpacking how MDM manifests within the vaccine SC and how different actors coordinate responses. We seek explanatory depth. Qualitative case study research is particularly suited to achieve that.

3.1 | Case Selection

Our study employed a qualitative, single embedded case study design (Ellram 1996; Yin 2009). Our single case (“MDM in the

vaccine SC”) consisted of multiple embedded units of analysis, including upstream, mid-tier, downstream, ancillary, and regulatory functions. This design was appropriate given the complexity of the SC and the need to understand interdependent relationships with unclear boundaries “between the phenomenon and context” (Baxter and Jack 2008, 545).

After obtaining approval from the university’s Institutional Review Board (IRB), we used purposive and snowball sampling strategies (Patton 2014) to identify organizations directly engaged in the COVID-19 vaccine SC. Firm involvement was verified through extant literature, public records, and the lead researcher’s prior practitioner experience. Once eligible firms were confirmed, participants who held positions within these organizations and had sufficient tenure were recruited.⁴ Snowball sampling allowed initial informants to recommend additional participants from connected firms and agencies. This sampling strategy is particularly effective in specialized networks (Noy 2008).

The number and composition of embedded subunits were clarified through iterative refinement during participant conversations and subsequent member checking. Ultimately, our subunits spanned pharmaceutical manufacturing, distribution, logistics, retail pharmacy, and public health. Our methodological framework enabled in-depth, contextually grounded insights into the operational, regulatory, and collaborative dimensions of pandemic-era SC coordination. The primary source of evidence was in-depth interviews with 24 participants from 12 firms, grouped into five embedded units. The embedded units were organized into five SC groupings reflecting distinct functional roles: retail pharmacies; supply chain intermediaries (e.g., PBMs and billing entities); state and federal regulatory governance bodies; logistics and distribution providers; and vaccine manufacturers.

In line with Yin’s (2009) guidance on purposeful case study design, we deliberately excluded participants from the SC’s most upstream (raw material suppliers) and downstream (consumers) nodes. This exclusion was intentional for two reasons. First, interview respondents indicated that raw material suppliers often lack knowledge regarding the specific products for which manufacturers use their materials. Consequently, holding them accountable for addressing MDM related to COVID-19 vaccines would be unwarranted. Second, extensive research has already examined factors influencing consumer vaccine hesitancy (e.g., Turner et al. 2021). Rather than contributing to this existing body of literature, our study aims to investigate how MDM is identified and combated by key decision-making nodes within the vaccine SC before vaccines reach consumers.

3.2 | Data Collection

A semi-structured interview protocol was designed, reviewed, and pilot-tested among several SCM academics. These reviewers were not directly involved in the present study, and their feedback ensured conceptual coherence of the instrument. The interviews were conducted to gain insight into how SC professionals perceive and navigate the challenges of MDM.

This line of inquiry helped us better understand the concrete actions taken in response. The initial set of questions arose from formulating our RQs, which in turn were derived from gaps in the existing literature. During each interview, informants began by providing their credentials and discussing their firm’s role within the SC before navigating through their familiarity with MDM, combat strategies, and perceived responsibilities. As our study progressed, our semi-structured questionnaire evolved to probe emerging themes identified by participants. Appendix 2 shows an overview of the final interview protocol.

Interviews were conducted between March 12, 2024, and March 20, 2025. Interviews lasted approximately 45 min. Before each interview, consent was obtained from the participant, and confidentiality was assured. All interviews were conducted remotely via an online meeting platform and immediately transcribed using Otter.ai. The lead researcher wrote extensive memos to reflect on the nature of the interviews, track the development of the coding framework, and discuss reflexivity regarding the researchers’ roles, risk of bias, and relationships with interviewees. Some participants also provided additional data (e.g., firm communications, playbooks), which were subsequently analyzed for triangulation.

While there are no fixed rules for interview counts, our sample of 24 aligns with established qualitative practices in SCM, particularly in studies on resilience strategies (e.g., Umar and Wilson 2024; Wang et al. 2025). As Malterud et al. (2016) note, “to offer sufficient information power, a less extensive sample is needed with participants holding characteristics that are highly specific for the study aim” (1755). Our sample included numerous senior executives from Fortune 500 firms actively involved in the vaccine SC. Moreover, recurring response patterns indicated that key themes and dimensions had been sufficiently captured. Table 1a presents a breakdown of interview participants included in the study. Table 1b contains firm-level information. The composition and diversity of the sample satisfy Eisenhardt’s (1989) requirement for a case study sample to be heterogeneous (various SC actors belonging to different firm types) and also, homogenous (all actors part of the COVID-19 vaccine SC).

Participant responses were triangulated across scholarly literature, the aforementioned exploratory news media analysis, and content analysis of archival data (i.e., corporate communications and publicly available informational materials). In doing so, we uncovered patterns, challenges, and innovations within and across the broader SC network. This included how MDM affected SC coordination, operations management, and vaccine distribution by focusing on the relational dynamics and information exchanges within these entities.

3.3 | Data Analysis

The data corpus was coded using NVivo 14. Coding procedures followed established qualitative research methodologies outlined by Saldaña (2021). We employed a concurrent data collection and analysis approach. This enabled us to identify emergent themes and issues in real time and to make iterative refinements to the

TABLE 1a | Participant demographics.

Participant	Years of work experience	Role	Participant firm	Firm type
A1	25+	Vice President, Pharmacy Operations	Firm A	Retail Pharmacy Chain
A2	15–20	Executive Director, Supply Chain	Firm A	Retail Pharmacy Chain
A3	25+	Executive Director, Supply Chain	Firm A	Retail Pharmacy Chain
A4	15–20	Executive Director, Pharmacy Operations	Firm A	Retail Pharmacy Chain
A6	15–19	Senior Vice President, Pharmacy	Firm A	Retail Pharmacy Chain
A11	15–19	Director, Pharmacy Operations	Firm A	Retail Pharmacy Chain
B5	20–24	Chief Clinical Officer	Firm B	Pharmacy/Medical Intermediary
C9	15–19	Director, Clinical Operations	Firm C	University Pharmacy Program
C10	25+	Director, Clinical Operations	Firm C	University Pharmacy Program
D14	15–19	Account Manager, Healthcare Billing Svcs	Firm D	Pharmacy Benefit Manager
E8	1–5	Senior Counsel, State Department of Health	Firm E	State Department of Health (DOH)
F7	15–19	Executive for Clinical Oversight	Firm F	Federal Gov't Health Agency
F18	10–15	Public Health Specialist	Firm F	Federal Gov't Health Agency
G12	25+	Director, Clinical Operations	Firm G	Pharmacy Logistics/Distribution
G17	5–10	Supply Chain Data Scientist	Firm G	Pharmacy Logistics/Distribution
H13	25+	Director, Pharmacy Operations	Firm H	Pharmaceutical Manufacturer
H15	25+	Vice President, Supply Chain	Firm H	Pharmaceutical Manufacturer
H20	25+	S&OP Leader, Vaccines	Firm H	Pharmaceutical Manufacturer
H22	15–19	Clinical Researcher	Firm H	Pharmaceutical Manufacturer
I16	1–5	Pharmacist	Firm I	Independent Pharmacy
J19	10–15	Pharmacy Manager	Firm J	Retail Pharmacy Chain
K21	25+	Director, Product Mgmt	Firm K	Pharmacy Logistics/Distribution
K23	25+	VP, Pharmacy Operations	Firm K	Pharmacy Logistics/Distribution
L24	15–20	Executive Director, Supply Chain	Firm L	Pharmaceutical Manufacturer

interview protocol as needed (Zeiser et al. 2025). Specifically, we employed iterative phases known as first and second-cycle coding methods. Charmaz's (2014) constructivist grounded theory approach guided our coding process. The 24 interview transcripts totaled 193 single-spaced pages with 5712 coded text segments.⁵ In the initial phase, we conducted line-by-line coding of the interview transcripts to identify the most significant themes and trends. For example, when asked about the most vital MDM combat tactics, one interview respondent noted how they engaged consumers who exhibited vaccine hesitancy due to MDM:

“One of the things that we learned, and we found this in medical literature and through physicians and others, is [that] when you want to influence someone

to [take a healthy action], they need a motivation. They need a reason... maybe for their children or their grandchildren”

(A1).

In this example, we captured the sentiments and tied them back to a broader concept of *storytelling/metaphor for motivation*, then categorized them under *training assets*, and finally abstracted them to *firm-level responses to combating MDM*.

Second-level coding synthesized and refined themes via higher-order abstraction (Charmaz 2014). This higher-level abstraction was initially sensitized to ST. As the analysis progressed, it became evident that ST alone was insufficient to fully explain the mechanisms behind MDM in the SC.

TABLE 1b | Firm demographics.

Participant firm	Firm type	SC tier	Firm size	Embedded unit
Firm A	Retail Pharmacy Chain	Retailer	100,000+	Retail Pharmacies
Firm B	Pharmacy/Medical Intermediary	Financial/Information Intermediary	< 1000	Supply Chain Intermediaries
Firm C	University Pharmacy Program	State/Federal Regulatory Governance	1000-5000	State and Federal Regulatory Governance
Firm D	Pharmacy Benefit Manager	Financial/Information Intermediary	10,000-25,000	Supply Chain Intermediaries
Firm E	State Department of Health (DOH)	State/Federal Regulatory Governance	< 1000	State and Federal Regulatory Governance
Firm F	Federal Gov't Health Agency	State/Federal Regulatory Governance	10,000-25,000	State and Federal Regulatory Governance
Firm G	Pharmacy Logistics/Distribution	Distributor	25,000–50,000	Logistics/Distribution
Firm H	Pharmaceutical Manufacturer	Manufacturer	50,000–100,000	Vaccine Manufacturer
Firm I	Independent Pharmacy	Retailer	< 1000	Retail Pharmacies
Firm J	Retail Pharmacy Chain	Retailer	25,000–50,000	Retail Pharmacies
Firm K	Pharmacy Logistics/Distribution	Distributor	50,000–100,000	Logistics/Distribution
Firm L	Pharmaceutical Manufacturer	Manufacturer	5000-10,000	Vaccine Manufacturer

Consequently, OIPT was later incorporated as a complementary theoretical lens to enhance explanatory depth and provide additional insight into how firms managed uncertainty and equivocality in their responses. Our analysis relied on constant comparison between emerging themes in the data and existing theoretical insights. Appendices 3A–E illustrate the resultant coding framework.

Reliability and validity were ensured through established qualitative case study practices (e.g., Eisenhardt 1989; Yin 2009). Theoretical sampling across diverse SC roles enhanced transferability by incorporating perspectives from multiple echelons of the vaccine SC. Detailed contextual descriptions enable readers to assess applicability to similar high-risk, information-intensive contexts. To strengthen credibility and dependability, the researchers reviewed codes at every level, had discussions to resolve differences, and achieved full agreement on the final coding framework. Member checking with selected participants confirmed the accuracy of the interpretation. The use of a semi-structured interview protocol and triangulation across interviews, archival materials, news media, and extant scholarly literature further strengthened internal validity and reduced single-source bias.

4 | Findings

We aimed to define the intricacy of the COVID-19 vaccine SC, highlight instances of MDM within it, and detail how MDM

propagates and impacts stakeholders. Our analysis yielded five overarching themes: (1) *The COVID-19 Vaccine Supply Chain*, (2) *MDM Forms*, (3) *MDM Outcomes*, (4) *Supply Chain Tactics for Combating MDM*, and (5) *Responsibility to Combat MDM*. To disentangle the individual components of MDM, we analyzed participants' sentiments and mapped the provided examples to their respective MDM types according to established definitions (e.g., Wardle and Derakhshan 2017). As shown in Appendix 4, all three forms were represented across participant remarks, though misinformation was by far the most pervasive. We will return to this particular finding in the Discussion section.

4.1 | The COVID-19 Vaccine Supply Chain

Prior research on vaccine SCs often isolated specific segments, focusing on simplified triads (i.e., manufacturers, 3PLs, and administration sites) (e.g., Kochakkashani et al. 2023) or on cold-chain logistics only (e.g., Lin et al. 2020). However, Carter et al. (2015) and Ashraf, Özpolat, et al. (2025) caution against overly narrow SC mappings. One participant noted, “The traditional supply chain is manufacturer to distributor to pharmacy” (A6), yet our findings revealed a far more intricate system. Our interviews revealed underexamined entities, including regulatory agencies, informal coalitions, and support structures such as financial and information-sharing platforms. It was quickly apparent that product, information, and financial flows were far more complex than typically conceptualized. We, therefore, categorized the COVID-19 vaccine SC

into upstream, mid-tier, downstream, and ancillary decision-making nodes, including government agencies, manufacturers (e.g., Pfizer, Moderna), logistics providers (e.g., Cardinal, McKesson), pharmacies, healthcare systems, insurers, and technology firms.

During the COVID-19 PHE, manufacturers produced vaccines, governments managed procurement and distribution, and regulatory bodies, such as the CDC, provided oversight (A6, C10, F7, F18). Logistics firms handled transportation, while pharmacies and clinicians administered vaccines (C9, G12, K21, K23). Ancillary actors (e.g., insurers and tech firms) played vital yet often overlooked roles with financing and information flows, supporting product movement from sourcing to consumption (B5, D14, K21). The urgent context introduced unique challenges: demand management required coordination between the Advisory Committee on Immunization Practices (ACIP) and the CDC (A3); logistics faced risks associated with cold-chain thawing (H15); and EUA approvals, particularly CDC signoff, served as critical gateways (A1, F18). Early on, government-funded manufacturing was paired with marketing to build trust (A6). Pharmacies and healthcare providers led customer relationship management (A1). Echelons were strained by issues like minimum order quantities and shifting distribution models (A4, H20). One participant noted that clinicians “did not want to make projections of their demand. They had no idea” (G12).

During this period, government programs and financial investments (i.e., Operation Warp Speed) and enhanced regulatory oversight further shaped the SC. Mandates ensured vaccines were available at no cost to uninsured consumers. Interviews also revealed significant examples of equipment flow (i.e., labels, vials, sub-zero freezers, and transport trucks). At the same time, regulatory reporting requirements at every stage emphasized the heightened importance of information flows but also challenged firms to collaborate and meet entirely new requirements. These findings extend research on SC control towers (Trzuskawska-Grzesińska 2017), highlighting the role of standards, compliance monitoring, and enforcement. Regulatory tasks acted as moderators, accelerating or impeding the exchange, sharing, and transformation of flows.

4.2 | MDM Forms Within the COVID-19 Vaccine Supply Chain

Understanding MDM in the COVID-19 vaccine SC requires examining more than conspiracy theories. MDM also involves conflicting guidance, billing confusion, concerns about product availability, and broader information gaps. Across interviews, misinformation was most frequently described, disinformation appeared primarily when participants attributed strategic manipulation to political actors, and malinformation was present but less common (see Appendix 4). Importantly, this reflects how operational SC actors experience MDM. Because malinformation involves technically accurate information shared with harmful intent, its identification requires more than simple fact-checking. Participants were far more attuned to overt falsehoods and politically attributed deception than to the amplification of truthful claims in misleading ways.

Participants repeatedly emphasized information voids as enablers of MDM. The absence of verified information allowed unverified or speculative content to flourish (C10, E8, G12, K21). As one respondent explained, “we were all needing to move 100 miles an hour with no information” (D14). Others cited persistent falsehoods such as fears of government tracking or infertility risks (A1, A6). Yet others noted delays in vaccine approval that sowed public confusion (A3). Misconceptions were also fueled by unclear billing rules and rapidly changing codes. These led to claim errors and denials (D14, K21). Unclear details on vaccine readiness for consumers were also quite challenging: “Misinformation surrounding vaccine availability and release timing further complicates the landscape” (A1). Uncertainty about whom to trust (i.e., government officials or social media) further exacerbated the problem. A2 questioned the strategic messaging from health authorities: “Did [Fauci] say [do not wear masks] so we are switching demand ... to preserve PPE?” Respondents also critiqued media amplification of rare side effects, with H22 pointing to how malinformation arose when actual but uncommon risks were disproportionately amplified “to get emotions stirred up.”

Consumers in clinical settings were deemed drivers of MDM. J19, a pharmacy manager at a large retail chain, recalled instances where “a bunch of firefighters showed up [mandated] to get their COVID vaccine...and it was a very unpleasant experience because none of them wanted to get it...They are all arguing about how bad a time it was that they had to be there.” Alongside consumers were clinical employees who questioned the scientific evidence. This same pharmacy manager recalled a “very vocal anti-vaccinator [employee] ... There were a couple of episodes where I even had to submit corrective action because they refused to bill for certain vaccines, or they refused to provide paperwork to a patient...because they were resistant to allow the patient to get a vaccine” (J19).

Extant literature confirms the “negative influence of political interests on vaccine programs” (Haldane et al. 2023). Participant remarks underscore this point, highlighting the federal government’s inadequate preparation in establishing robust guidelines for disseminating the first waves of vaccines, which led to disparate outcomes. A1 noted, “I think [the issue driver] was [our government partners] not asking the questions, and us making a political choice not to say ‘here is the shitstorm that’s about to occur.’” A6 critiqued the perception of effortless distribution, stating, “People just think that a 747 [from a manufacturer] is going to parachute pallets into stores.” A disconnect emerged between public perceptions and the complex logistical realities of vaccine distribution.

A recurrent reluctance of political leaders to acknowledge challenges further hindered vaccine distribution efforts. A1 criticized the government’s handling of information dissemination, stating, “Even when a clinical expert, like Dr. Fauci, said something, we discounted him because we thought he was political.” The erosion of trust in public health experts driven by politicization ultimately undermined efforts to convey accurate information about vaccine distribution and administration. Supporting empirical evidence suggests that statements by elected officials downplaying the severity of COVID-19 and promoting unverified treatments contributed to MDM (Bolsen and Palm 2022). As

a result, political identities influenced the public's understanding of the pandemic, leading to decreased compliance with vaccination efforts.

4.3 | MDM Outcomes on the COVID-19 Vaccine Supply Chain

One severe consequence of MDM was the proliferation of confusion among customers. This contributed to disparities in vaccine access and heightened vaccine hesitancy. Inaccurate clinical prompts in ERP systems led to misunderstandings, creating patient skepticism about the necessity of certain vaccines (B5). At the same time, patients turned to social media for information (B5, C10, L24). These dynamics fueled hesitancy at sites of administration and inflamed tensions over initial eligibility. Respondents described this as controversial and confusing. Hesitancy impeded efforts to achieve widespread immunity. This prolonged the pandemic's impacts, including the prevalence of the disease and increased levels of otherwise preventable deaths (C10, G17, L24).

MDM also created confusion within the SC. A data scientist working for a large distributor said: MDM “leads to uncertainty, and uncertainty leads to fluctuations in delivering the products on time. So, mitigating this...is part of risk management” (G17). A6 noted that unclear messaging led to product wastage. A4 highlighted the challenge that pharmacists face in billing vaccines to insurance plans, where rejections without clear explanations disrupt financial flows and inhibit vaccine administration. These impacts amplify the bullwhip effect (A4). D14 also raised concerns about billing inaccuracies, while H13 hit the broader concern: “*A business has to make money.*” MDM led to rework in billing systems. Addressing these issues required collaboration, technology, and trust-building (A4, A6, B5). Clinicians struggled to navigate this information void. This aligns with research showing that premature product launches can increase reputational risks and consumer confusion (Anand et al. 2014), even though early testing confirmed the vaccines' efficacy (Bown and Bollyky 2022).

Additionally, MDM introduced confusion in government decision-making. Participants described how inconsistent messaging from political leaders and federal agencies fostered uncertainty. For example, one recalled then-President Trump's remarks about injecting disinfectant and other unproven treatments such as ivermectin, noting the risk that “whatever you say [is taken] as gospel” (C10). Shifting federal guidance on eligibility, dose timing, and booster requirements compounded the issue. It was “too much information” (A11). It left people feeling overloaded and uncertain about what to do. Operation Warp Speed was rebranded under the new administration, and the turnover of political appointees “created gaps in information” during a critical period (F7). At the state level, governors' misperceptions about vaccine hoarding contributed to public distrust. As one participant explained, “we had information going around that [our state governor] had vaccines somewhere and that he just was not giving them out” (J19). The urgency of the vaccine rollout, combined with fragmented and politicized messaging, created fertile ground for rumor and speculation. Conspiracy theories circulated that the vaccine would “change

your DNA” or cause the immune system to go “haywire” (A11, C9, C10).

MDM also spurred inaccurate reporting within the SC. Participants described breakdowns ranging from billing mistakes and missed claims (D14) to misaligned inventory reports and public confusion when products were technically “*approved*” but not yet available (A1). These inaccuracies mattered because reporting functions as the communicative backbone of the SC. When data and updates are unreliable, pharmacies and other frontline actors become the de facto “*mouthpiece*” to patients (B5). This amplified downstream uncertainty and weakened trust in the system.

4.4 | Supply Chain Tactics for Combating MDM

Participants confirmed that SC actors employ various tactics to combat MDM. However, while recent streams of research emphasize the role of advanced technology (e.g., Akhtar et al. 2023; Kar et al. 2023), such technologies were notably absent from SC actors' strategies. However, collaborative partnerships did emerge. One vaccine manufacturer's director explained: “We had to continually work with [wholesalers] so that they understood what was happening in the background, to give them a sense of security” (H13). At the government level, the Administration for Strategic Preparedness and Response (ASPR) convened stakeholders to support the coordination of an equitable response to COVID-19 by supporting access to medicines, deploying critical medical supplies and equipment, and advancing the research, development, and distribution of tests, treatments, and vaccines (O'Connell 2023). Informal coalitions across SC actors leveraged prebunking to correct MDM, with one executive noting, “We quickly corrected each other ... behind the scenes working along the operations team ... to combat misinformation” (B5).

Even more salient, though, firms deployed in-house strategies to combat MDM. This included creating FAQs, role-playing, and webinars (A1, H20). But manual tactics had limits. A clinical pharmacist observed: “Even if you have [training and FAQs], you're probably going through it quickly and not being able to have those authentic conversations with patients” (H22). Downstream administration sites prioritized outreach to vulnerable groups, leveraging trusted leaders and professional recommendations (A1, A6, C9). Storytelling proved particularly potent for downstream nodes: “We started...just telling stories, true stories ... and I would prompt the [colleagues] I traveled with to tell their story” (A1). These sentiments resonated with research from Xiao et al. (2023) on the power of narrative framing. Webinars on social media tackled myths, with segments like “Lie of the Week” to address MDM examples (C9). Low-tech resources such as the CDC microsite and the Surgeon General's toolkit were crucial (CDC 2023) (E8). ASPR's Practical Playbook and manufacturer-led initiatives, such as Pfizer's updates, clarified concerns about mRNA (HHS 2021; Pfizer 2021). These documents reinforced these efforts but were not considered significant attempts to combat MDM compared with those of downstream SC partners.

Lastly, legal actions, such as lawsuits against noncompliant businesses and internal disciplinary measures for staff who

“brazenly” opposed vaccination (J19), further helped preserve information integrity but created ideological battles within the broader community over perceived slant.

4.5 | Responsibility to Combat MDM in the Supply Chain

MDM prompted nuanced reflections on responsibility. While the duty to combat it was widely acknowledged, participants perceived it as unevenly distributed (A11, F7, F18, H20, K21, D14, L24). Frontline entities (i.e., pharmacists and healthcare providers) were often seen as bearing the heaviest burden due to their direct interactions with consumers. One interviewee noted, “Your job as a healthcare provider is to give them the most accurate information so they can make an informed decision” (C10). Another pharmacy-based participant added, “We have to be the source of the truth ... We are accountable for doing that” (A11). A pharmacy manager at a large chain emphasized, “The clinicians on the front lines ... probably are more likely to feel the immediacy of that pressure ... because that’s the last step, the last hurdle” (J19). This consumer proximity positioned downstream nodes of the SC as bearing the greatest responsibility for dispelling MDM.

A chief clinical officer warned MDM “weakens the system in ways that you feel repercussions for years” (B5). Yet, many frontline participants expressed frustration that responsibility was not shared more equitably. Participants criticized upstream actors, especially manufacturers, for insufficient early engagement. A distributor stated, “Realistically ... I don’t think that every company has the moral obligation to solve every problem” (K21). A clinician argued that manufacturers engaging in direct-to-consumer marketing “have a responsibility,” while bemoaning the perceived lack of effort (A1). A manufacturer representative countered: “We tried direct-to-consumer marketing, but it is so restrictive” (H13). The government was also viewed as critical but problematic in addressing MDM. One interviewee emphasized, “The government’s job needs to be to protect its people as best it can” (A2). Another added, “The burden for addressing [MDM] was on the government ... to correct it” (F7). Efforts, such as offering facility tours to government representatives, aimed to enhance trust and partnerships (L24). However, slow government responses were seen as detrimental: “The federal government is slow, right? ... When you have to be right, you’re typically slow” (F7).

Responsibility emerged as proportional to an actor’s place in the SC and their capabilities. One participant explained, “Maybe the supplier of the glass vial has a very different role” (H15). Others emphasized differences based on firm size (F18) and domain expertise, such as distributors focusing on logistics rather than clinical concerns (I16). Participants emphasized the need for a more shared burden upstream, noting the limited urgency (H20) and strained pharmacy partnerships: “We had to navigate gingerly by not allowing people to think it’s a [pharmacy] issue, but not throwing our partner under the bus” (A3). Overall, clarifying roles, fostering collaboration, and balancing moral and practical considerations were essential to ensure accurate communication across the SC but not always achievable.

5 | Discussion

MDM disrupts both vaccine acceptance and operational stability across the SC. This creates challenges demanding stronger collaboration, transparency, and communication. While Themes 1 (*The COVID-19 Vaccine Supply Chain*) and 2 (*MDM Forms within the COVID-19 Vaccine Supply Chain*) provided necessary context, our theorizing centers on Themes 3 through 5. Interpreted through OIPT and ST, these findings clarify how actors interpret, respond to, and allocate responsibility for combating MDM.

First, we further examine the theme of *MDM Outcomes on the COVID-19 Vaccine Supply Chain*. OIPT explains why crisis-induced waves of MDM can overwhelm even established vaccine SCs. Exogenous shocks like COVID-19 intensify uncertainty and equivocality, increasing exceptions and overloading the system. In our data, we observe four outcome patterns: customer confusion, government confusion, SC confusion, and inaccurate reporting. Taken together, these reflect a classic OIPT misfit, in which there is more information to process, more interpretations to reconcile, and insufficient mechanisms to handle them. Echoing Zhu et al. (2018), these “shortfalls indicate a lack of adequate information-processing capability to analyze, interpret, and act upon the information.” (51).

OIPT specifies that organizations must either reduce information-processing requirements or increase information-processing capacity (Galbraith 1974). Effective engagement, therefore, requires the SC to maintain clearer information flows, more equitable participation, and stakeholder capability-building (Adekola and Chia 2024). Complementing this, from an ST perspective, these mechanisms strengthen stakeholder relationships by enhancing transparency, mutual understanding, and alignment of expectations (Co and Barro 2009). In doing so, improved information processing can reduce information asymmetries (anchored in OIPT) and support confidence in shared decisions (anchored in ST). This leads us to our first proposition, presented in two parts:

Proposition 1a. *When crisis-induced MDM elevates uncertainty and equivocality beyond the SC’s information-processing capacity, it produces an information-processing misfit that manifests as four classes of adverse outcomes: customer confusion, government confusion, supply chain confusion, and inaccurate reporting.*

Proposition 1b. *To mitigate information-processing misfit, organizations must expand information-processing capacity through enhanced coordination mechanisms (e.g., protocols, verification routines) and cross-tier communication channels.*

For the next theme, *Supply Chain Tactics for Combating MDM*, we further examined how SC actors perceive their relationship to MDM and with one another as they attempt to combat it. Our findings suggest that under crisis-induced MDM, actors default to ad hoc, firm-specific measures and fragmented roles. Complementary insights come from threat-rigidity theory, which explains why organizations under pressure tend to narrow information processing and revert to familiar

responses rather than experimenting with new approaches (Mazzei et al. 2025).

Shifting from OIPT to ST, these behaviors can be understood through crisis-driven reconfigurations of stakeholder salience (PLU). Rather than shifting uniformly, PLU's three attributes shifted unevenly across tiers. First, at crisis onset, urgency dominated: "100 miles an hour with no information" (D14) as vaccine development unfolded in "time-warped" fashion (H13). Fears of increased patient suffering and mortality intensified pressure to act rapidly. Second, power is concentrated among upstream actors controlling policy and allocation decisions. As one participant explained, "you've got the federal government who was actually procuring the product... [while states were] determining allocations" (A4). Lastly, as the crisis evolved, legitimacy became increasingly contested. Politicization undermined trust (i.e., discounting Dr. Fauci). False expectations triggered perceptions of untruthfulness ("you lied to me," K23), while conflicting communications further eroded legitimacy. As such, legitimacy pressures became concentrated downstream to frontline clinicians and locally embedded actors. The result was PLU divergence across SC tiers: urgency dominated early, power was perceived to be concentrated among upstream/institutional actors (e.g., regulators and manufacturers with authority over supply allocation and public guidance), and legitimacy migrated downstream, producing fragmented rather than coordinated mitigation. Under these conditions, attribution of MDM's specific forms appeared subordinated to containment.

Combating MDM rarely rose to the level of a collective agenda. Instead, SC actors relied on internal psychosocial tactics (i.e., prebunking, FAQs, messaging, and storytelling), targeted to their own consumers or employees. Donaldson and Preston (1995) note that cooperation depends on stakeholders' confidence that their interests will be coordinated to yield mutually favorable outcomes. However, as one participant observed: "When there wasn't a clear direction, it left everyone to create their own thoughts...there wasn't a clear pathway" (B5). In the absence of PLU convergence, responses tended to remain siloed. Here, PLU convergence refers to the extent to which SC actors' perceptions align across dimensions of power, legitimacy, and urgency of a stakeholder issue. This leads to the first part of our second proposition:

Proposition 2a. *Facing crisis-induced MDM, the perceived convergence of stakeholder salience (power, legitimacy, and urgency) across SC actors is positively associated with the use of collective, cross-tier MDM mitigation strategies (e.g., coalitions, cross-tier messaging).*

Beyond shaping coordination among SC actors, the crisis environment also influenced how actors diagnosed and categorized the forms of MDM they encountered. Returning to Appendix 4, misinformation was the most frequently reported form of MDM. Prior research distinguishes misinformation, disinformation, and malinformation along two conceptual dimensions. Wardle and Derakhshan (2017) highlight "dimensions of harm and falseness" to differentiate forms of MDM (5). Figure 2 adapts this perspective into a 2X2 matrix defined by a claim's veracity and degree of harmful intent. In addition to the three established

(Source: Authors, concepts adapted from Wardle & Derakhshan, 2017)

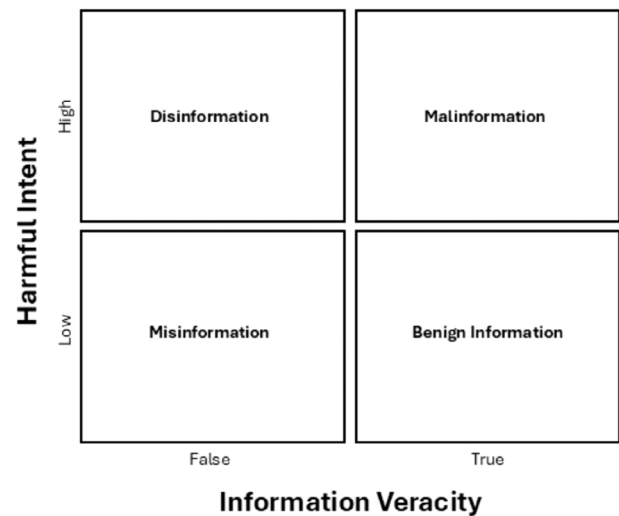


FIGURE 2 | MDM typology matrix (Source: Authors, concepts adapted from Wardle and Derakhshan 2017).

MDM categories, we add a fourth quadrant representing benign information (i.e., non-MDM). The figure illustrates an underlying pattern observed in our data: actors prioritize correcting veracity while deferring intent attribution. As a result, misinformation and disinformation (both characterized by low veracity) were frequently conflated, while malinformation was comparatively underdiagnosed.

Mapping participants' mitigation strategies onto this logic reveals a clear skew toward correcting falsehoods, with comparatively limited attention to assessing harmful intent. It appears, then, that when stakeholder salience diverges, actors tend to rely on siloed tactics (e.g., FAQs, tasking frontline clinicians with direct persuasion, prebunking tactics, etc.), which limit the overall effectiveness of the SC's response. These dynamics lead to the second part of our proposition two:

Proposition 2b. *In the early stages of a crisis characterized by high perceived urgency, SC actors rely more heavily on veracity-correction strategies than on intent-attribution strategies when diagnosing MDM. This results in limited differentiation among misinformation, disinformation, and malinformation. Actors defer intent-based distinctions in favor of rapid containment strategies.*

Lastly, our analysis reveals disparities in how SC actors perceive responsibility for combating MDM. ST helps clarify this dynamic by illustrating how crisis conditions reshape stakeholder salience: urgency increases across the system, but legitimacy and power do not shift proportionally. As a result, responsibility shifts toward those downstream actors closest to the consumer. Consumer-facing firms (i.e., sites of administration) bear heightened responsibility because they face the most urgent demands. Sites of administration anchor close relationships consumers have with local clinicians and doctors. This emphasizes strong expectations for legitimacy. ST emphasizes that organizations have moral and strategic obligations to their key stakeholders. They must safeguard their legitimacy (Mahajan et al. 2023). As

legitimacy coalesced downstream, so did the burden of maintaining public trust and mitigating MDM.

At the same time, OIPT suggests that higher levels of uncertainty increase information-processing demands, which, in turn, require downstream actors to develop greater communication and transparency capabilities (Zhu et al. 2018). Examples are plentiful. Downstream nodes led efforts such as the American Pharmacists Association Academy's (APhA) "Vaccine Confident" program (APhA 2023). Governments relied on media cascades via entities like the CDC and health departments. Conversely, manufacturers, distributors, and ancillary third parties faced weaker pressures and thus played a more minor role. This pattern underscores a disproportionate burden downstream.

Co and Barro (2009) note that cross-tier collaboration fosters trust, where stronger upstream engagement enhances message credibility. Although MDM poses a threat to public health and SC stability, upstream firms were perceived as having deflected responsibility. As one participant from a vaccine manufacturer reflected on their firm's standing: "I don't think there's probably the urgency as much there" (H20). Downstream nodes were left to address widespread consumer confusion. Consider just one of MDM's potential outcomes: vaccine hesitancy in consumers. Surveys indicate that only 57% of U.S. adults have confidence in the safety of the COVID-19 vaccine (KFF 2023). The tactics to address MDM have not been wholly efficacious. More needs to be done to address stakeholders' concerns. Effectively addressing MDM requires a more unified SC response that shares responsibility and improves public trust and resilience. Political and contextual factors also shaped the distribution of responsibility by destabilizing legitimacy upstream. Hence, we present our third proposition:

Proposition 3. *When crisis conditions reconfigure stakeholder salience across SC tiers, actors experiencing greater*

legitimacy and urgency (particularly downstream consumer-facing actors) perceive greater responsibility and engage more actively in MDM mitigation strategies.

Our case study of MDM responses in the COVID-19 vaccine SC offers a more nuanced understanding of how MDM impacts performance and the SC strategies employed to address it. Figure 3 distinguishes among misinformation, disinformation, and malinformation (Wardle and Derakhshan 2017). It situates these dynamics within a vaccine SC inspired by the nodes and links used by Carter et al. (2015). The framework illustrates how an exogenous crisis both catalyzes MDM and dynamically affects PLU configurations. As perceived responsibility for mitigating MDM intensifies downstream (depicted by the increasing size of the gray arrow), confusion and vaccine hesitancy become increasingly concentrated at the point of consumption. To preserve clarity, the figure abstracts upstream (i.e., materials providers, manufacturers, R&D), mid-tier (wholesalers, warehouses), and downstream (pharmacies, hospitals, clinics). Additionally, the framework incorporates ancillary, often overlooked SC actors (e.g., logistics providers, financial intermediaries, technologists, and informal coalitions) whose salience fluctuates during crises. Government regulation and oversight span the vaccine SC and shape interactions across upstream, mid-tier, and downstream actors.

This framework further differentiates between SC-level and firm-level response strategies. SC-level responses include collaborative partnerships, information sharing, regulatory interventions, and legal actions. Firm-level responses rely more heavily on tactics such as messaging, training assets, population prioritization, and community engagement. Notably, respondents described a relative underutilization of advanced technological solutions as compared to low-tech measures. From an OIPT perspective, limited engagement with advanced technology could reflect a mismatch between the unexpected crisis-induced surge

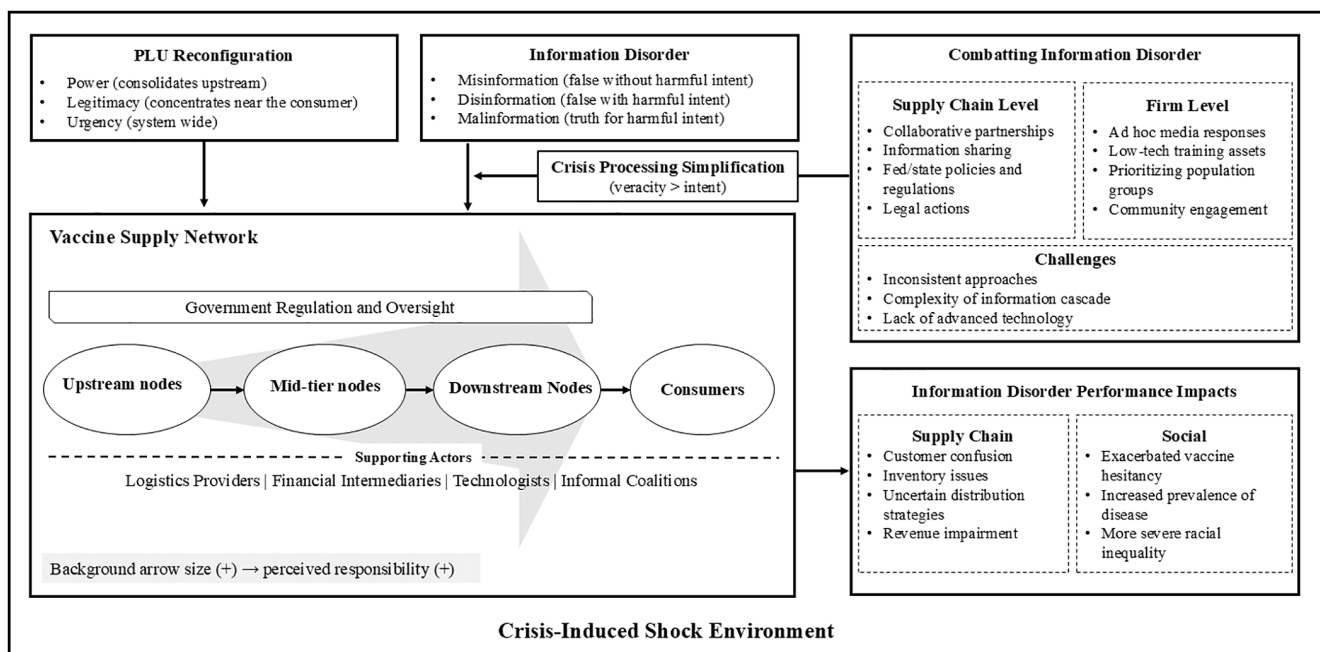


FIGURE 3 | Conceptual framework for MDM in the vaccine supply chain.

in information-processing demands and firms' limited capacity to respond (e.g., Galbraith 1974; Srinivasan and Swink 2018). From an ST perspective, this response also makes sense. According to Mitchell et al. (1997), reconfigurations of PLU can lead to "one-sided stakeholder action" (870). Because effective SC information sharing often requires shared technological infrastructure, unilateral stakeholder actions may deter such coordination for information exchange. This could therefore explain more reactive patterns of siloed communication and improvised messaging, rather than systemic, data-driven countermeasures to MDM. Ultimately, our model demonstrates that SC actors prioritize addressing veracity over harmful intent and therefore employ tactics primarily aimed at correcting falsehoods. This leaves the SC exposed to the impacts of malinformation.

Finally, our figure expands on performance and social consequences. It shows how MDM contributes to consumer confusion, inventory distortions, shifting distribution strategies, and revenue impairment. These SC outcomes, in turn, heighten social costs by exacerbating vaccine hesitancy, worsening public health outcomes, and deepening health inequalities.

6 | Conclusion

The pandemic catalyzed an urgent need to address MDM. MDM does not just foster public health issues. It disrupts SC operations.⁶ Kar et al. (2023) call for SCM academics to better prepare for "black swan" events. This study demonstrates that crisis-induced MDM reshapes SCs along three fronts: it overwhelms information-processing capacity, fractures cross-tier coordination, and shifts the practical burden of response disproportionately onto downstream actors. Our evidence suggests that crisis-induced MDM arises from an exogenous shock that increases uncertainty and equivocality beyond capacity, thereby overwhelming exception handling (Galbraith 1974). In parallel, crisis-induced salience shifts (via PLU) reshuffle which stakeholders set priorities. These dual impacts hamper convergence between SC actors on shared mitigation tactics. In short, information-processing misfit and salience reconfiguration are mutually reinforcing. This explains why firms struggle to organize a holistic, SC-wide response to MDM. Reactive, firm-specific measures, such as stakeholder education, targeted outreach, and ad hoc media responses, prove insufficient to address evolving threats. Our three resultant propositions offer prescriptive actions SCs should undertake to strengthen their ability to handle unexpected MDM surges in the future.

Additionally, our findings speak to extant research on SC information distortion. The bullwhip effect (Lee et al. 1997) explains how operational and forecasting dynamics amplify upstream demand variability. Later, Wang et al. (2005) extended this logic by introducing the "extended-bullwhip effect," broadening the scope of distortion beyond systematic forecasting parameters to include irregular uncertainty in SC decision-making. However, both variants primarily theorize endogenous sources of distortion. Our findings suggest that MDM represents a distinct exogenous trigger condition. Participants described instances in which MDM altered demand-planning inputs, disrupted forecasting accuracy, and triggered rationing and gaming. Yet, unlike endogenous amplification, MDM enters SCs from outside

the network, reshaping demand expectations, stakeholder salience, and operational responses across tiers. In this sense, MDM may constitute an informational shock that extends existing information distortion theory beyond endogenous amplification mechanisms.

6.1 | Contribution

This study offers both theoretical and practical contributions. For the former, it broadens the conventional representation of the vaccine SC by incorporating a wider set of decision-making nodes than prior models typically capture (e.g., Georgiadis and Georgiadis 2021; Golan et al. 2021). Mapping this fuller ecosystem clarifies why assessing stakeholder salience becomes especially challenging under urgent crisis conditions. By taking this approach, we address Carter et al.'s (2015) call to strike a balance between simplicity and complexity in conceptualizing SC structures.

Additionally, this study brings OIPT and ST together as complementary lenses to explain how crisis-induced shocks overwhelm information-processing capacity and reconfigure stakeholder salience. Traditionally, OIPT links performance to task complexity and the fit between information-processing requirements and organizational capacity (Srinivasan and Swink 2018). We extend this understanding by demonstrating that uncertainty and equivocality can also be externally induced through MDM. This creates information-processing challenges exceeding organizational (and SC) capabilities. Likewise, we show how MDM reshapes PLU through crisis-related MDM spikes that marginalize specific stakeholders' knowledge claims (Adekola and Chia 2024). Ultimately, shifting PLU destabilizes shared responsibility within the SC. OIPT and ST, when used together, therefore provide a unified theoretical lens that links breakdowns in information processing with the dynamics of stakeholder salience. This integrated perspective helps explain both why MDM generates widespread operational disruption and why coordinated responses fail to materialize. Methodologically, by leveraging Charmaz's (2014) constructivist analysis approach, we respond to Wieland et al.'s (2024) call for more constructivist contributions in SCM. Finally, our resultant framework lays a foundation for future empirical tests of proactive MDM mitigation in PHE SCs, with implications for resilience and stakeholder trust.

Practically, this research offers actionable strategies for SC managers to combat MDM more effectively. First, it highlights the need for shared accountability mechanisms that distribute responsibility in combating crisis-induced MDM across the SC. Downstream nodes (i.e., pharmacies, clinics, providers) carry a disproportionate share of the burden, while upstream actors often disengage. SC managers should formalize joint response protocols across tiers (i.e., shared media guidelines, rapid fact-verification networks, and cross-tier communication task forces). This could enhance the SC's ability to handle increased information loads. Second, collaborative partnerships, transparent communication, and synchronized messaging appear critical to dispelling MDM. SC managers should build coalition mechanisms (e.g., pre-crisis communication templates, shared message hubs, pre-agreed escalation protocols) to enable rapid,

coordinated responses during crises. Third, our findings detail effective low-tech tactics (i.e., storytelling, FAQs, prebunking, role-playing, and clinician-led conversations) that resonate with hesitant populations. In the near term, SC managers should focus on scaling and systematizing proven human-centered interventions. However, in the long term, they must incrementally invest in inclusive digital tools that bring all stakeholders into the ecosystem and expand the SC's information-processing capacity. Ultimately, combating MDM requires a comprehensive approach combining human expertise and technological advancements to develop robust, trustworthy SCs.

6.2 | Future Research and Limitations

This study has limitations. Its qualitative, U.S.-centric scope limits generalizability. More insights are needed to address the unique challenges of low- and middle-income countries (LMICs). Future research should broaden participation, conduct cross-national comparisons, and examine contextual factors like regulatory environments, media ecosystems, and cultural attitudes toward MDM. Quantitatively measuring stakeholder PLU could refine our understanding of salience (Mitchell et al. 1997). Future research should further examine how SC actors can recognize, diagnose, and mitigate malinformation by identifying harmful intent, and how the temporal reconfiguration of stakeholder power, legitimacy, and urgency (PLU) during evolving crises influences when and how different forms of MDM are diagnosed and addressed. Building on our extension of Wardle and Derakhshan's (2017) typology through the inclusion of benign information within a 2×2 framework, future research should explore distinctions between benign and beneficial intent, evaluate whether additional dimensions (e.g., informational relevance) expand the typology, and develop frameworks that help SC actors diagnose intent during crisis-induced shocks. Additionally, the impact of MDM on key SC dynamics (i.e., buyer-supplier relationships, manufacturing capacity management, and demand forecasting) warrants further exploration.

Building on Hughes et al. (2025), this study highlights a need for greater scholarly attention at the intersection of public policy and SC resilience. Research should explore whether inequitable responsibility patterns in vaccine SCs mirror those in other contexts (e.g., manufacturing recalls or agribusiness food safety). They should also assess the long-term effects of mitigation strategies. This should also include a deeper analysis of the news media supply chain and its role in influencing the framing of information flows consumed by SCs (e.g., Dubois 2024, 2025; Dubois et al. 2026).

Current SCM research emphasizes the use of advanced technologies such as AI and blockchain as a strategy to combat MDM (Akhtar et al. 2023; Kar et al. 2023). Our participants reported relying primarily on reactive, non-technological strategies to address crisis-induced MDM. As noted in seminal OIPT scholarship, firms should “invest in mechanisms which allow [them] to process information...without overloading the hierarchical communication channel” (Galbraith 1974, 32). Future research should therefore move beyond evaluating the impact of technology to examine its inclusivity. SCs succeed through information sharing (Zhou and Benton Jr 2007). When navigating crises,

organizations are more likely to default to familiar responses (Mazzei et al. 2025). Therefore, future research should also examine how digital tools can be designed to be more accessible and equitable for SC actors, enabling implementation ahead of future disruptions.

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Conflicts of Interest

The authors declare no conflicts of interest.

Endnotes

- ¹ While optimal processes were required to distribute vaccines to worldwide populations effectively, much has since been written about COVID-19 vaccine wastage and distribution inequity, countering claims of efficient SCM (e.g., Lazarus et al. 2022). Also, researchers have noted concerns about the global supply chain's exacerbation of inequality in low- and middle-income countries (Haldane et al. 2023).
- ² Health scholarship has covered a variety of drivers for vaccine hesitancy, such as distrust in authorities, safety concerns, religious beliefs, and even fear of needles (Turner et al. 2021).
- ³ LexisNexis was queried with the Boolean terms (“COVID-19” AND “vaccine misinformation” AND “responded”).
- ⁴ A majority of participants had more than 15 years of professional experience.
- ⁵ The count of coded segments is specific to the interview data corpus only and does not count further coding of triangulation material.
- ⁶ As of March 2025, the role of MDM in the vaccine SC remains urgent, highlighted by the resignation of top FDA vaccine official Dr. Peter Marks, who cited an “unprecedented assault on scientific truth” and criticized federal leadership for embracing misinformation over evidence-based health policy (Casey and Perrone 2025).

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Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Appendix 1.** Diverse streams of literature on MDM and SCM/healthcare impacts. Table 2. Semi-structure interview protocol (IRB-approved). Table 3A—Coding framework for the COVID-19 vaccine supply chain. Table 3B—Coding framework for information disorder forms. Table 3C—Coding framework for MDM outcomes on the COVID-19 Vaccine Supply Chain. Table 3D—Coding framework for information disorder combat tactics and challenges. Table 3E – Coding framework for perceived responsibility. **Appendix 4.** Participant Examples of MDM.