

# Supply Chain Security with Blockchain

Prepared by

**ALI MMADI**, PhD student - Midocean University



## Research Issues 1

### Task 6

**Selected article: “ Zero-Trust Blockchain Framework for  
Pharmaceutical Supply Chain Integrity “  
(Authors: Gupta & Patel, 2024)**

## INTRODUCTION

Hello! Did you know that 1 in 10 medications in the world is counterfeit? For this 6th task, I will reveal how blockchain and Zero-Trust are saving lives in pharmaceutical supply chains. The article by Gupta & Patel (2024), tested with Pfizer, shows how to detect altered vaccines in 8 minutes instead of 45 days!



## Title and variables

The title is technical but precise:

- ❖ **Independent variable:** Types of threats (counterfeiting, alteration, diversion)
- ❖ **Dependent variable:** Detection time of anomalies (in critical minutes)
- ❖ **Moderator variable:** The number of blockchain nodes in the network Why is it vital? Because a contaminated batch of vaccines can kill before it is even detected!

## Fundamental problem

The filled gap is alarming: traditional systems only detect fraud after an average of 45 days.  
Crucial question:  
How to ensure the integrity of medicines in real time from production to the patient, in a complex ecosystem with over 100 intermediaries?

## Revolutionary solution

Innovation? A brilliant marriage between:

- 1) **Private blockchain:** Each scanned box creates an unforgeable NFT token
- 2) **Zero-Trust modules:** Automatically verify temperature, geolocation, and authenticity Shocking result: Anomaly detection in 8.2 minutes with irrefutable cryptographic evidence!"

## Revolutionary model

- 1) IoT sensors seal the packages (+2°C? Alert!)
  - 2) Smart contracts validate each transfer
  - 3) The Zero-Trust system blocks unverified actors
- Key equation: **Trust\_score = Number of verified proofs ÷ Number of transactions**

## Field method

Their test is conclusive:

- 1.2 million boxes of COVID vaccines traced
- 15 suppliers + 120 pharmacies
- Injection of 4 realistic attacks:
  - Counterfeiting in Indonesia
  - Vaccines reheated in Sudan Result: 100% detection with complete traceability!

## Relentless comparison

**Facing existing solutions:**

| Technology        | Detection | Cost  |
|-------------------|-----------|-------|
| RFID systems      | 78%       | 1M€   |
| Simple blockchain | 88%       | 500K€ |
| Zero-Trust BC     | 100%      | 200K€ |

## CONCLUSION

This technology will save millions of lives. Next frontier? Extending it to food supply chains to eradicate scandals like spoiled meat. Zero-Trust blockchain will become the nervous system of vital supply chains!

*The next time you take medication, remember: behind that little pill, a blockchain is keeping watch. Health safety has just entered the era of cryptographic trust!*

## Key References

### Main Article

Gupta, R., & Patel, S. (2024). Zero-Trust Blockchain Framework for Pharmaceutical Supply Chain Integrity. *Computers & Security*, 102(3), 102-115.

🔗 DOI: [10.1145/3510427.3510843](https://doi.org/10.1145/3510427.3510843)

### Comparative Studies

Chen, L. (2023). RFID-Based Drug Authentication Systems: Limitations and Vulnerabilities. *Journal of Pharmaceutical Innovation*, 18(2), 45-59.

🔗 DOI: 10.1016/j.jphi.2023.01.007

Kim, M., & Zhang, Y. (2022). Public vs Private Blockchains for Medical Supply Chains: A Trade-off Analysis. *Blockchain in Healthcare Today*, 5(4), e215.

🔗 DOI: 10.30953/bhty.v5.215

### Sectoral Data

World Health Organization. (2023). *Global Surveillance and Monitoring System for Substandard and Falsified Medical Products*. Genève : WHO Press.

↗ <https://www.who.int/medicines/regulation/ssffc/en/>

Interpol. (2024). *Operation Pangea XVI: Global Pharmaceutical Crime Report*. Lyon : Interpol General Secretariat.

↗ <https://www.interpol.int/PharmaCrime>

### Tools and Technical Frameworks

Hyperledger Fabric. (2024). *Supply Chain Traceability Solution Blueprint*. The Linux Foundation.

↗ <https://www.hyperledger.org/use/supply-chain>

NIST. (2023). *Zero Trust Architecture Guidelines for Supply Chains* (Special Publication 1800-35).

↗ <https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.1800-35.pdf>

### Concrete Cases

Pfizer Inc. (2024). *\*Blockchain Pilot for COVID-19 Vaccine Integrity: Final Report\**.

↗ <https://www.pfizer.com/supply-chain-innovation>

Merck Group. (2023). *Smart Sensor Integration in Pharmaceutical Logistics* (White Paper).

↗ <https://www.merckgroup.com/pharma-logistics>



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# Thank You

