



Title: Product DNA

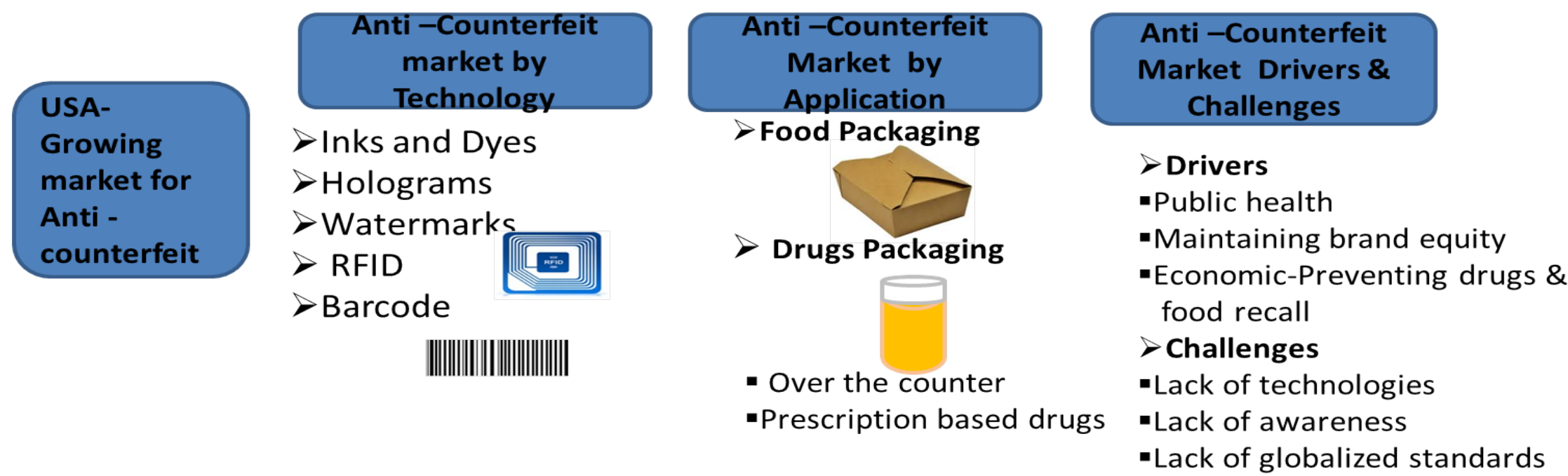
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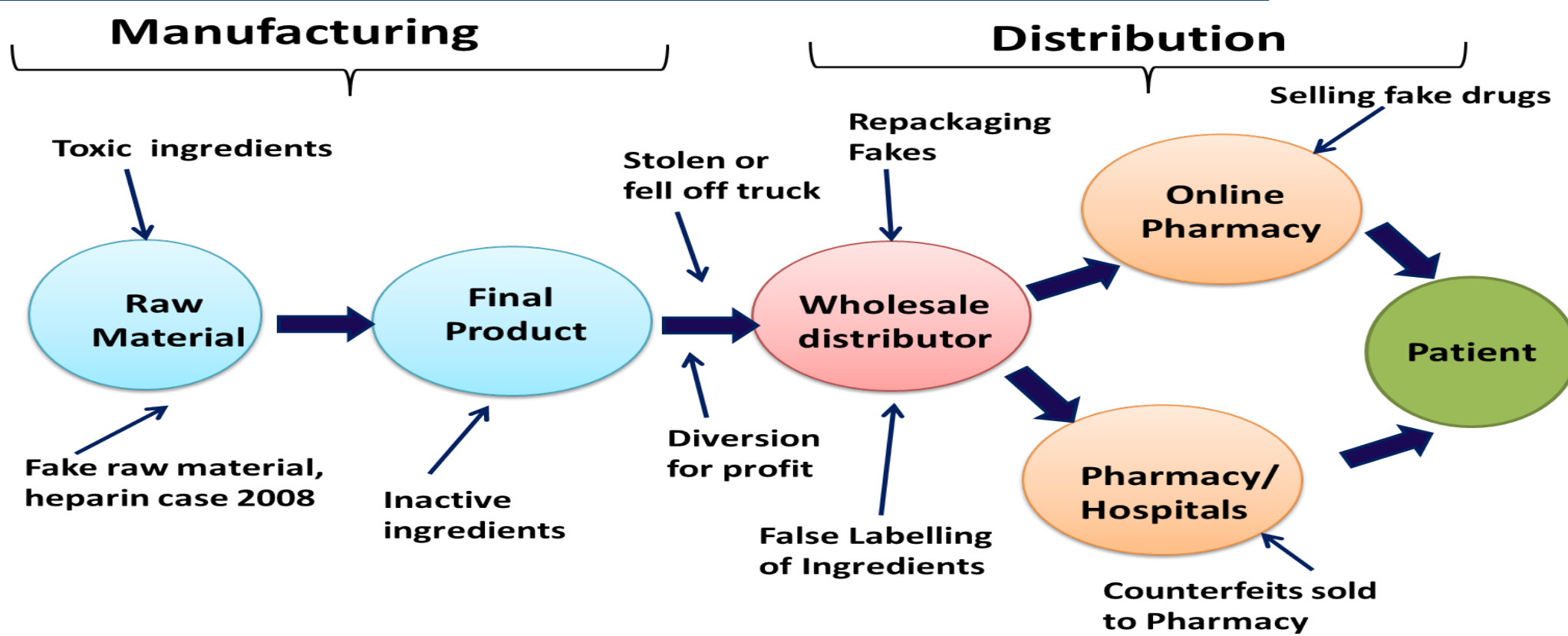
1. Research Project & Axia Theme

➤ Anti-Counterfeiting Market

Anti-Counterfeit market: Technology, Applications, Challenges and Drivers

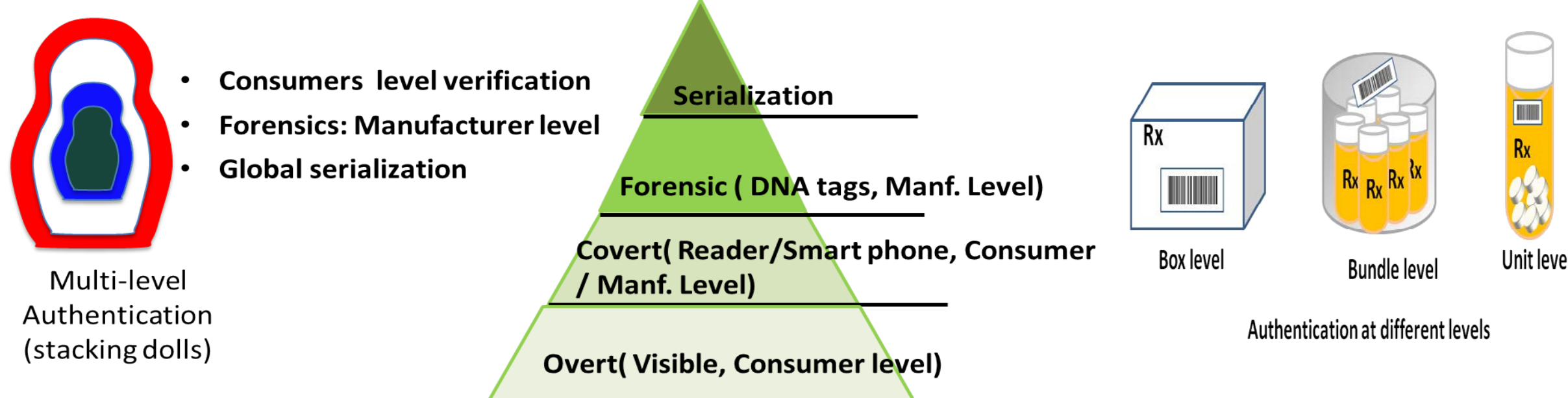


➤ Complexity in modern supply Chain: Example of pharmacy



- **Multilevel Authentication System** : A multi-level authentication system :Difficult to copy but easy to verify by end user.

Multilevel Authentication for added security



➤ Leveraging MSU's expertise in nanomaterials, RFID, genomics, and packaging.

Using existing technologies for user level authentication and combining them with advanced nanotechnologies to add a manufacturer-level authentication. MSU expertise in nanomaterials, RFID, packaging materials and supply-chain monitoring can be utilized.

- **Project theme:** To develop next generation anti-counterfeiting technologies for pharmaceutical and food products which allows multi-level authentication.
- Develop Product DNA barcodes (PDB) : Unique markers for each product .
- Consumer level authentication: RFID, optical , smart phone readers
- Manufacturer level authentication: DNA coated nanomaterial tags

2. Value Created

➤ Global counterfeiting of drugs and food expected to grow 20 % annually

Global sales of anti-counterfeiting packaging technologies in the drug and food industries are projected to reach \$74.2 billion with North America being the largest market for anti-counterfeiting packaging technologies. This project will help improve package design, supply chain network, and supply chain management against counterfeiting activities.

➤ Monitoring supply chain

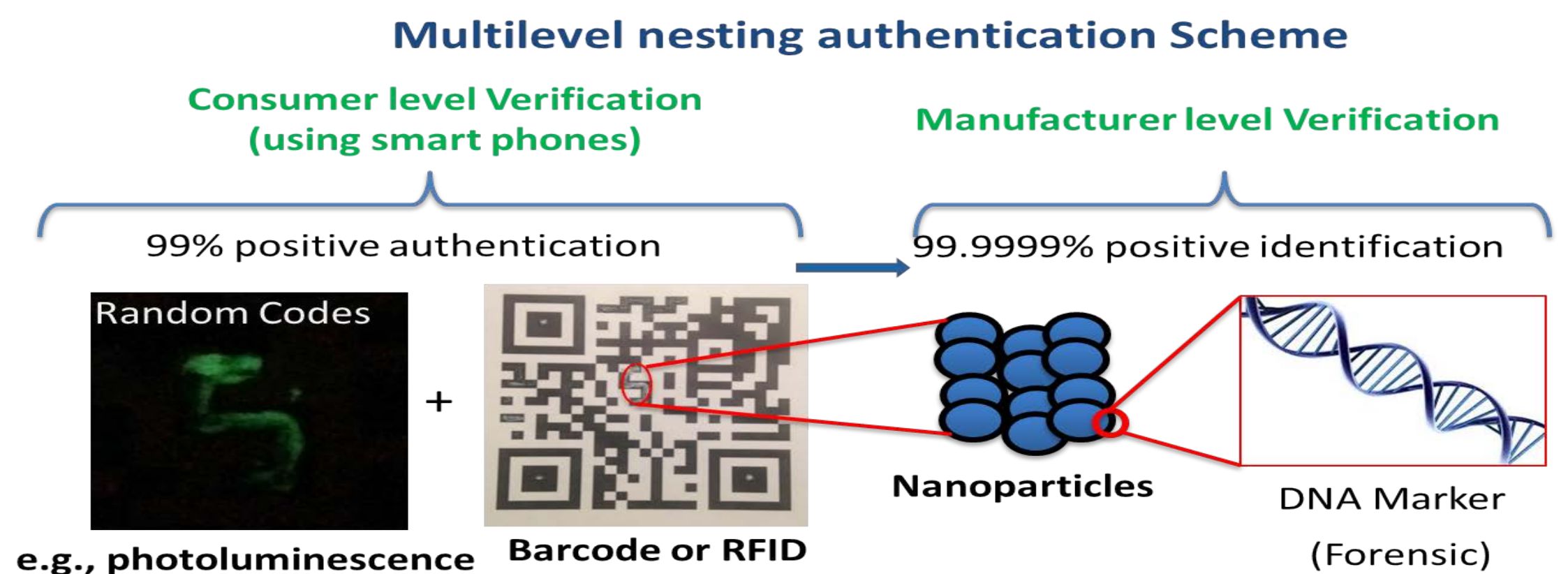
Monitoring of food and drug product supply chain is important towards preventing counterfeiting drugs and food causing morbidity, mortality, and loss of confidence in the healthcare system. The PDB system will protect patients from fraudulent drugs and shield consumers from adulterated foods.

➤ Multilevel authentication system

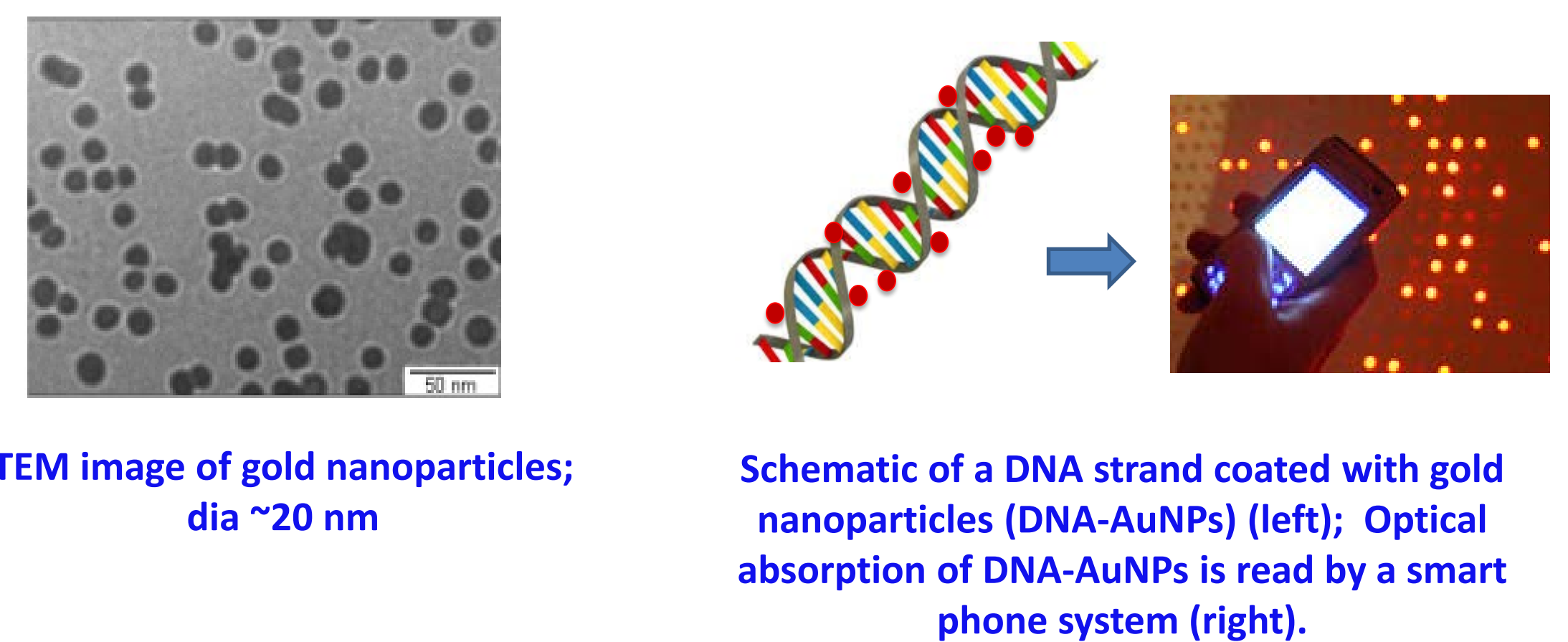
Multi-level high security authentication system that is difficult to copy but easy to check. A system that is compliant with international standards and can be changed periodically with little cost.

3. Results/Future Directions

➤ Multilevel Authentication Scheme using Product DNA barcodes

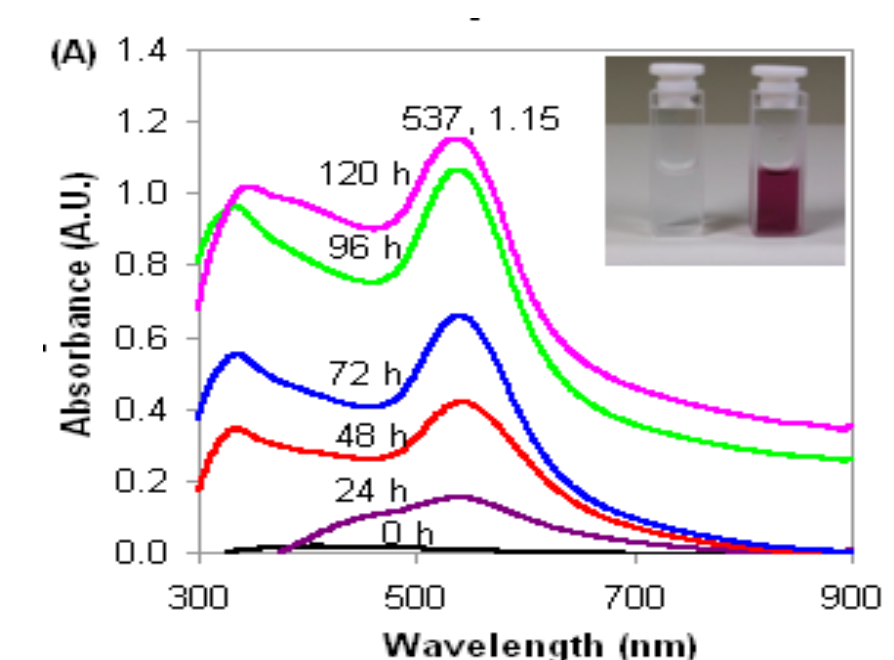


➤ Nanoparticle Synthesis and DNA coating on DNA strands



➤ Future direction:

- Investigate existing anti-counterfeiting technologies (ACTs) such as RFID, optical, inks. Use these technologies to design authentication markers.
- Design Apps for smart phones for consumer level verification.
- Synthesize nanoparticles and determine potential DNA markers to make product DNA barcode (PDB).
- Integrate PDB with packaging materials for overt verification.
- Design the PDB reader.
- Assess the challenges in globalized serialization process.



4. Project Plan

➤ Milestone1: Consumer level verification

- Assess the state-of-the-art Anti-counterfeiting technologies (6-12 months)
- Study the FDA regulations and standards (6 -12 months)
- Use of multiple technologies (RFID, optical barcode, randomized ink printing etc.) to authenticate a product. (up to 18 months)
- Design RFID, nanoparticle readers and interrogation protocols (2 years)
- Smart Phone Apps for reading multiple authentication markers (up to 3 years)

➤ Milestone 2: Manufacturer level

- Study DNA sequences for tagging (1 year)
- Synthesize nanoparticles and coat them with DNA sequences to form product DNA barcodes (PDBs) (up to 2 year)
- Validate the efficacy of the system in drug and food packaging materials
- Integration into packaging materials (3year)
- Approaches to verify against secured database (3 year)