Tracking BioSamples on Hyperledger Blockchain

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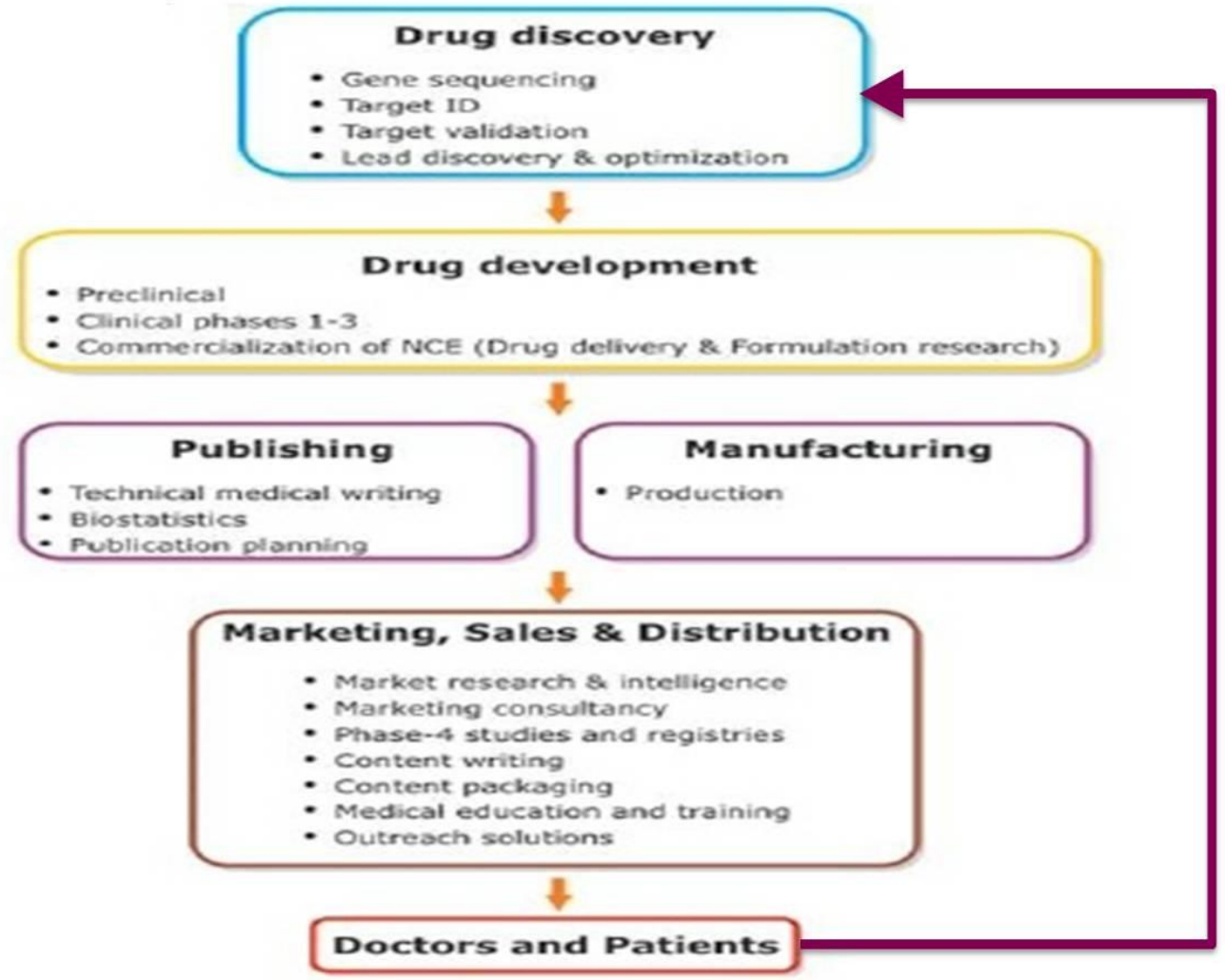
The growing need for provenance in the supply chain of biomedical “samples”

- Genetic samples
- Screening samples
- Reagents
- Tissues & Cells
- Animals
- Active Pharmaceutical Ingredient (API)
- API Precursors
- Clinical Trial Samples
- Packaged Medicines
- Samples from Patients
- Etc.



The Medicines’ Value Chain

BioSamples as surrogate for other biomedical samples

- BioSamples stores and supplies descriptions and metadata about biological samples.
- Industry and academic
- Search, submit, and curate
- Useful, relevant source of data on some key biomedical sample types
  - Mainly tissues, cell lines etc. for genomic research
  - Surrogate for other types of biomedical sample

BioSamples : Opportunity

- Room to augment functionality
  - Enable better sample tracking and provenance: Through a workflow or supply chain
  - Provide additional layers of security to the identifier
- Include the protocols used to produce the samples.
- Use blockchain technology to support provenance and sample supply chain management

Blockchain

Blockchain is a collection of technologies (cryptographic security, decentralization, digital registry, smart contracts, rules and incentives to collaborate among institutions with different levels of trust) .

OpenScience requires provenance, transparency, and availability.

Blockchain delivers the trust layer in OpenScience.

Blockchain approach:

- BioSamples already provides a standard for submitting samples and links to the information; this is a digital asset.
- Well defined protocols used to produce the samples can be seen as operations that spawn new samples; transactions acting on the digital assets.
- Blockchain(s) that registers interactions on the sample repository.
- Provide secure access to samples and protocols through permissioned channels across the network

Hacking project objectives

1. Identify the added value of Blockchain technologies on BioSamples and similar sample management tools.
2. Create a prototype on Hyperledger Composer of a Business Network (BNA) that includes the data standards and current functionalities (workflows) of BioSamples.
3. High-level design of the (Fabric) network that will support the BNA.
4. Extend BioSamples to include other complementary digital assets: protocols, laboratory notebooks (if time permits).

Tasks (day 1)

Blockchain technologies and Biosamples (data and workflows)

1. Tutorial on Blockchain technologies (9-11)
2. Tutorial on Hyperledger Composer (11-12, 13-15).
3. Sample use cases: Blockchain4openscience and Digital Diplomas.
   - Skills: JS.
   - Output: learn Composer-Playground.
4. Understanding BioSamples: data management and workflows (15-19).
   - Skills: BioSamples.
   - Output: Identify data structures and workflows.

Tasks (day 2)

Supply chain management in BioSamples

1. How would BioSamples benefit from blockchain technologies: How would the distributed ledger be used across industry and academia? (9-12).
   - Skills: BioSamples.
   - Output: BioSamples workflow.
2. Designing and implementing a business network application (*.bna) on Hyperledger Composer for the project: version 1 and 2.
   1. Define assets and participants (13-14).
   2. Define transactions and logic in JS (13-19).
      - Skills: JS.
      - Output: BioSamples.bna

Tasks (day 3)

Supply chain management in BioSamples

1. Write-up first report and document (*.bna) for PoC on Composer-Playground (9-11:30).
2. Report (11:30-12).
3. High-level introduction to Hyperledger Fabric. (13-15).
4. Designing a distributed ledger for BioSamples and similar sample management tools for deployment in Hyperledger Fabric (15-19).
   - Output: Value chain in Biosamples (organization, channels..)
4. Designing front-ends (15-19).
   - Skills: AngularJS. Output: Mock-ups.

Tasks (day 4)

Presentation and roadmap

1. Writing-up a presentation for the project (9-11:30).
2. Report (11:30-12).
3. Documenting (GitHub repo) and roadmap.