

Managing Quickly Changing Requirements at Agile Speed in an Early Stage Startup

Business Objectives

- Solve unmet needs of Clinical Trials Management in Healthcare & Pharma Industry
- Few Business professionals with deep knowledge in pharma industry came together to solve critical problems with clinical trials

Focus on

- Innovation
- Clinical Trials
- Drug Development
- Technology
- Cloud
- Blockchain
- Application User Experience



Product Objectives

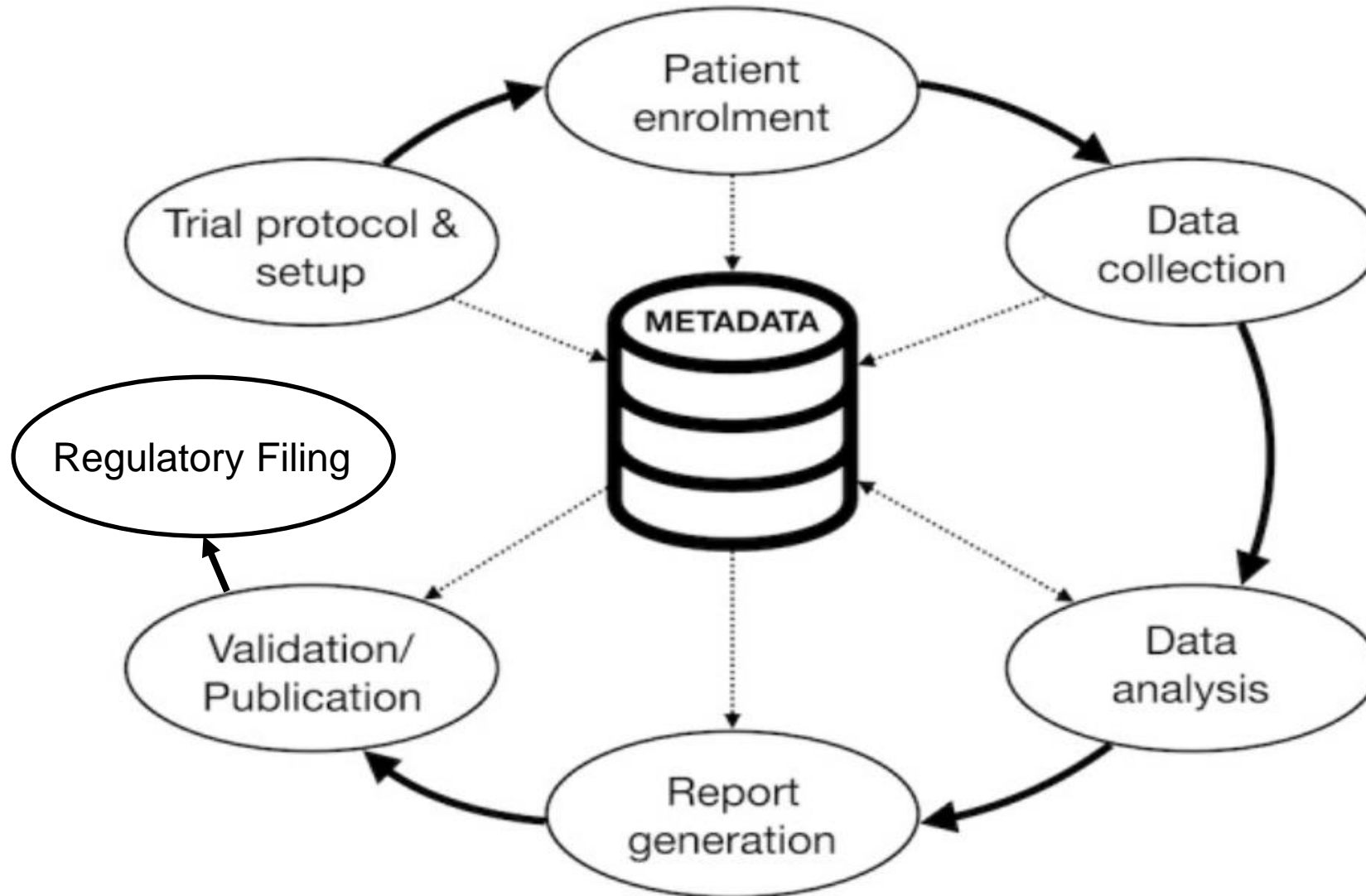
- Blockchain will be mandatory
 - Explore Hyperledger vs Ethereum for blockchain
- Encompass relevant compliances and certifications
 - Regulatory guidelines under **Title 21 CFR Part 11 & HIPAA** needed to be maintained
- Experts had to Impart domain knowledge to Tech team
- Cost conscious product development
- “A working software is a true measure of success“

Application Objectives



- Solve problems in the clinical trial workflow
 - An integrated solution that is smart, secure and speedy
 - Implementation of simple payments system
 - Reduce cost involved in trials
 - Speedy clinical trials collecting real time data
 - Automate as many workflow steps as possible
 - Case Report Form (CRF) completed by physician

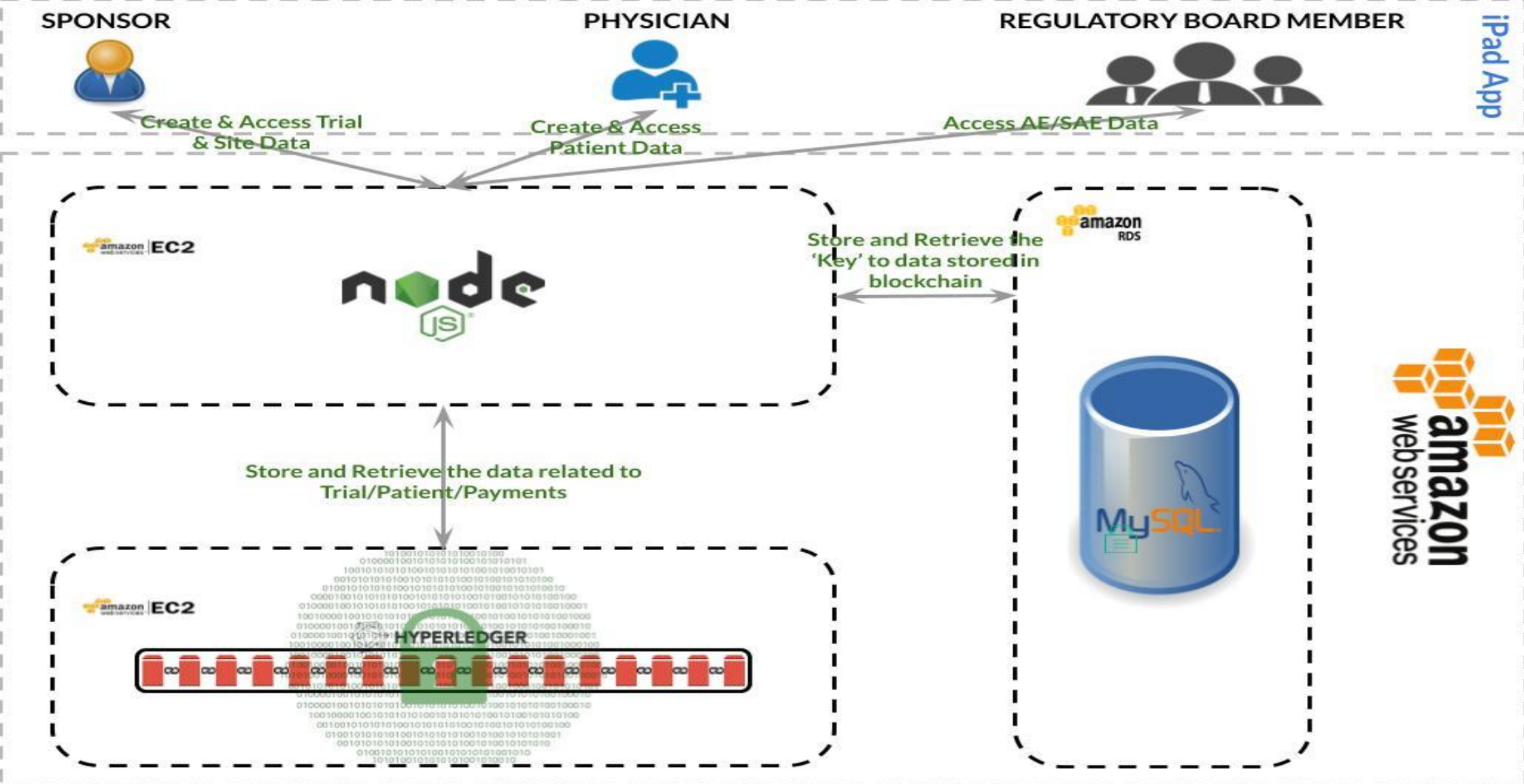
Clinical Trial Overview



Participants

- Trial Stakeholders
- Trial Sponsors
- Sites, Physicians, Patients

Technical Architecture



Product Milestones Roadmap

- Proof-of-Concept (POC)
 - Validate core concepts, finalize on Tech Stack, etc.
- Alpha
 - Focus on Metastatic Melanoma use case
 - Technology Demonstrator
- Beta
 - Regulatory Compliance/Audit preparation
 - Complete Pre-audit & commit code changes
 - Documentation (proof that we are following SOP (Standard Operating Procedure))



POC - Development



- iPad form factor
 - Patient Consent form (~200 fields – text, image, audio, video)
 - Data display (demographics, combination of relevant data)
 - Payment (budget, debit, balance, expenditure forecast, etc.)
 - Push notification of reminders/alerts
- Blockchain-NodeJS
 - Expose REST APIs to be consumed application
 - Authentication
 - Encryption (SHA256 for HIPAA, 3 levels of encryption)
 - Store blocks for patient and rules in Hyperledger

POC - Development...Continued



- Application Flow
 - Patient provides details
 - Physician completes Case Report Forms (CRF)
 - Check for AEs and SAEs (Severe Adverse Events)
- Security Measures
 - Encrypted data in motion & storage
 - Rules stored in blockchain
 - Validation in the server and blockchain

Alpha Development



- Finalize high level functional flow
 - Workflow captured in Whimsical tool
- Converge on product features and third party integrations
 - Creating epics and broad level user stories in Jira tool
- Define overall systems architecture with interplay of all systems
 - Source control repository with Github
- Identify key personas and define unique roles & permission sets
 - Map user journey and workflows
- Identify iPad as the primary device for usage of the application
 - Enhanced security, mobility, performance, availability

MVP 1.0 Development Continued



- Idea validation
 - Use of blockchain in clinical trials (3-4 months)
 - Ensure integrity in data store & retrieval
- Select Payment gateway
 - Develop payment workflow
 - Sandbox testing
 - Able to transact direct bank payments
- User Interface & Experience
 - Reduce cognitive load for users considering the user persona and improve the efficiency while capturing data as accurately as possible

Challenges Faced Managing Development



- Lack of industry tested solutions in blockchain and clinical trials
- Hyperledger fabric was evolving. Full support version was unavailable making integration of blockchain with rest of the system open ended
- Implementation of chaincode had to be in GoLang while the application was developed in node.js
- Docker container logs had to be referred for debugging during chaincode implementation.
- Fabric SDK removed older functions instead of deprecating
- Too much logging in default configuration resulted in reduced debugging efficiency.
- No testing framework available

Managing Changes



Evolution to stable versions

- Started with Hyperledger Fabric 0.6; planned an upgrade to 1.4; subsequently to 3 different versions in the process
- Started with Swift 3 for MVP and migrated it to Swift 4.2

Agile practices

- Ensuring a 2 week sprint cadence
- Product backlog grooming and story reprioritization as per business requirements
- Effective mapping of roadmap to epics and user stories using Jira
- Feature augmentation as per validated learnings
- Focus on value driven prioritization and development

Lessons Learned



- Selection of technology had to be based on “nature of the problem” and NOT on the “latest technology”
- Blockchain offered a suitable solution to requirements of clinical trials through its distributed ledgers, cryptographic structures and data immutability.
- Targeted problem solving before evolving the product
- Customer journey consideration required to provide value prop to both users as well as buyers.

Thank you!

Hosting details

- AWS EC2 for application server and blockchain
- AWS RDS for database
- AWS S3 bucket for storing signed HIPAA / informed consent forms, transaction details and CRF data.

Agile Maturity Model

PRACTISE	AGILE MATURITY				
	POOR	AVERAGE	GOOD		
AGILE					
Daily stand-up					
Stand-up documented and shared with client					
Release Planning					
Sprint Planning					
Sprint Demo					
Sprint Retrospective				FOLLOWED	=
Burn down chart					
Engagement Retrospective				NOT FOLLOWED	=
DEVELOPMENT				PARTIAL	=
Version Control Software					
Continous Integration					
Peer code review					
Code analysis tools					
Automated unit and functional tests					
Regression test bed					
Issue tracking system					
QUALITY ASSURANCE					
Issue tracking system					
System test strategy / test plan					
Test case / test plan management system					
Test case execution traceability					
Automated Regression test bed					
Evolving regression test bed					

Users & Roles - Functions

User \ Functions	Create Master Data (Site, Users, etc)	Create Trial	Assign Trial to Site	Assign Trial to Physician	Create Patient	Create CRF	Create Patient Diary	
Super Admin	YES							
DSMB								
Sponsor		YES	YES	YES				
Site Admin								
Physician					YES	YES		
Site Coordinator					YES			
Patient							YES	

Users & Roles - Permissions

User \ Permissions	Manage Other Users and Sites	Patient Data	Trial Data	Trial Finance Data	Drug Details	Initiate Trial	Recruit Patient	Safety and Efficacy Data
Super Admin	YES							
DSMB		YES	YES		YES			YES
Sponsor			YES	YES	YES			
Site Admin			YES					
Physician		YES	YES			YES	YES	
Site Coordinator		YES				YES	YES	
Patient								

HIPAA Security Rule Overview

The Security Rule requires appropriate administrative, physical and technical safeguards to ensure the confidentiality, integrity, and security of ePHI

1. Administrative Safeguards

- Refer to the internal policies and procedures to maintain oversight of the privacy and security of patient data according to HIPAA standards
- Mainly around Access Controls, Audit, Authentication, Transmission

2. Technical Safeguards

- Refer to the protection of electronic storage and communication of data
- Mainly around devices and media control

3. Physical Safeguards

- Refer to the physical access to the data
- Facility Access Controls, Policies, H/W & S/W safeguards within premises

Product Management

- Chose to stick with one type of clinical trial and built the system around it
- Intentionally did not generalize the system so that we don't deviate from the concept of MVP
- “A working software is a true measure of progress“
- MVP developed in about 6-8 months

Product Management Challenges

- No prior experience with clinical trials
- Complex domain
- Minimal clinical domain documentation available
- Developed guideline document for reference

User Interface & Experience

- Finalize iPad for its touch sensitivity, availability of accessories, device portability, sturdiness and ease of use
- ~ 200 input fields to capture patient data in suitable groupings
- Reduce cognitive load for users considering the user persona and improve the efficiency while capturing data as accurately as possible