831458 – Trials@Home

Center of Excellence – Remote Decentralised

Clinical Trials

WP2 – TECH

D2.6 An interconnected, fully tested technology platform that connects the technological solutions chosen for the technology package and supports the WP3 pan-EU Pilot

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Document History

Version	Date	Description
1.0	12.09.2023	Initial release

Abstract

This report offers a comprehensive overview of the testing, deployment, and maintenance of the RADIAL technology package throughout its initial release and subsequent phases. The RADIAL study encompasses a diverse array of clinical trial approaches across distinct study arms, each leveraging unique sets of technologies and functionalities. Within this report, we provide details on the integration of technology components, present our testing strategy, and describe our governance framework. Notable features include the systematic approach to UAT, the Dry Run, risk assessment, and the pivotal role of the governance team in overseeing and managing updates to the technology package.

1. Introduction

Briefly, the RADIAL Study is a bring-your-own-device (BYOD) study where participants use their own mobile device to install the Clinpal® Mobile App to access the study's interfaces. The study is designed to test three discrete clinical trial approaches in two different study parts:

In Part A, two distinct arms are employed. On one hand, Arm 1 (see Appendix 7.1) adopts a conventional study approach, wherein all participant visits and interactions with healthcare professionals (HCPs) take place in person at the physical study site. Conversely, Arm 2 (see Appendix 7.2) embraces a hybrid study approach, featuring a combination of in-person participant visits and HCP interactions conducted at the study site, as well as remote interactions from the participants' homes.

In Part B, we exclusively have one arm, namely Arm 3 (see Appendix 7.3), crafted as a fully remote, decentralized clinical trial. Within this arm, all participant visits, and interactions with HCPs are seamlessly conducted from the comfort of the participants' homes, without any physical presence required.

The distinct design entails that each arm of the RADIAL Study incorporates a unique array of technologies and functionalities to cater to its specific requirements. To illustrate these differences effectively, a high-level schematic representation of the RADIAL Study arms' designs, along with the technology distinctions, is presented in Figure 1.

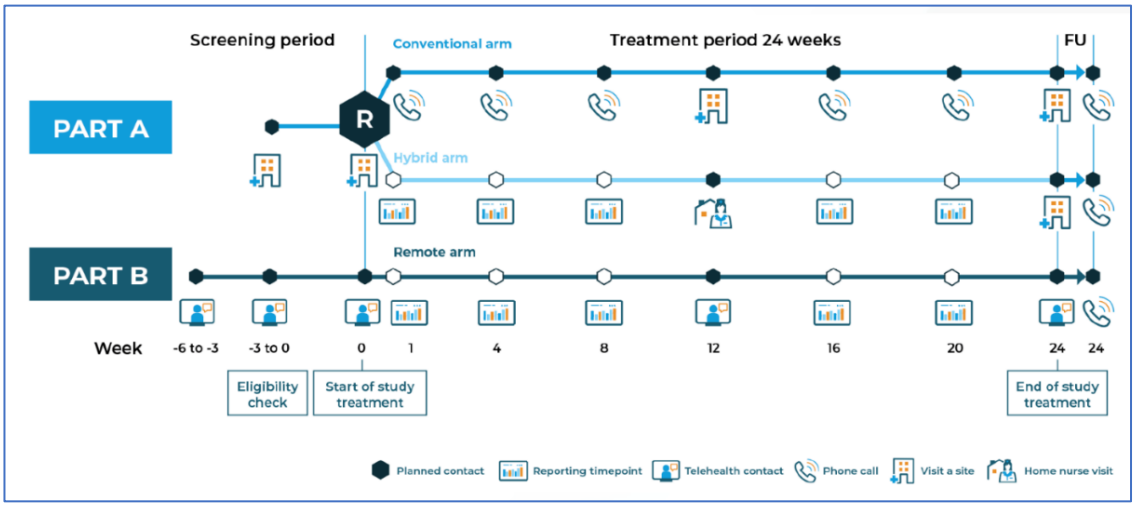


Figure 1. the RADIAL Study arms' designs

2. Technology Components and Devices

The scope of the study is facilitated by a range of DCT technologies and devices. Table 1 presents the vendors, DCT technologies utilized, installation types, and their relevance to specific study parts.

Table 1. RADIAL technology components and installation type

Vendor	Technology Component	Installation	Relevant Part(s)
AARDEX	MEMS Adherence Software (MEMS AS®)	Custom	A (arm 2), B
AARDEX	MEMS® Mobile App	Custom	A (arm 2), B
eClinical Health	Radial Study App	Custom	All
eClinical Health	Clinpal® Platform (branded as RADIAL Study Portal)	Configured with custom components	All
Investis Digital	RADIAL Study Website	Custom	B
Signant Health	SmartSignals Telemedicine® (previously 'Virtrial Telemedicine')	Configured with custom components	B
Signant Health	SmartSignals RTSM®	Configured with custom components	All

The RADIAL study also incorporates the use of a smart cap device for tracking medication adherence and blood glucose meter devices, commonly referred to as glucometers. Please refer to Table 2 for more details regarding these devices.

Table 2. RADIAL devices for measuring glucose and tracking medication adherence.

Vendor	Devices	Brand/Version	Relevant Part(s)
Biocorp	Mallya® Smart Cap	1.0	A (arm 2), B
Roche	Glucometer – Accu-Chek Guide	N/A	All

Vendor	Devices	Brand/Version	Relevant Part(s)
Roche	Glucometer – Accu-Chek Instant	N/A	All

3. Integration of Technology Components

In the context of RADIAL, the central hub is formed by both the RADIAL App and the Clinpal® platform, with each playing a pivotal role in ensuring a unified and highly efficient data exchange process. Table 3 illustrates the various integrations, data direction, and the diverse data exchange mechanisms employed to guarantee seamless data exchange within RADIAL's technology ecosystem. These mechanisms encompass a spectrum of technologies, including application interfaces (APIs) with bearer tokens, standard API integrations, deep linking for precise user interactions, Bluetooth APIs facilitating wireless device connectivity, REST APIs enabling web-based data exchange, and event-triggered integrations designed to automate responses to specific conditions. This multifaceted approach collectively ensures a smooth and secure transmission of data across all components of the RADIAL technology package in an integrated and streamlined data exchange process.

Table 3. RADIAL Technologies and integration details

Vendor	Technology System(s)	From	To	Format	Type
AARDEX	MEMS AS®	Clinpal® Server	MEMS AS® Server	XML	API with Bearer Token
AARDEX	MEMS AS®	MEMS AS® Server	Clinpal® Server	JSON	API
AARDEX	MEMS® Mobile App	MEMS® Mobile App	Clinpal® Mobile App	N/A	Deep Link
AARDEX	MEMS® Mobile App	MEMS® Mobile App	MEMS AS® Server	N/A	Vendor Managed
Biocorp	Mallya® Smart Cap Device	Mallya® Smart Cap Device	MEMS® Mobile App	Bluetooth®	Bluetooth® API
Roche	Glucometer – Accu-chek Model: Guide®	Glucometer – Accu-chek Model: Guide®	Clinpal® Mobile App	Bluetooth® defined	Bluetooth® API
Roche	Glucometer – Accu-check Model: Instant®	Glucometer – Accu-chek Model: Instant®	Clinpal® Mobile App	Bluetooth® defined	Bluetooth® API

Vendor	Technology System(s)	From	To	Format	Type
Signant Health	SmartSignals Telemedicine®	Clinpal® Platform	SmartSignals Telemedicine®	JSON	API (bearer token)
ID Now	AutoIdent®	Clinpal® Platform	AutoIdent® VideoIndent (for site users)	PDF documents	Data Exchange via REST API
Marken® Clinical Trial Logistics	N/A	Clinpal® Platform	Marken® email mailbox	Email	Event triggered
Marken® Clinical Trial Logistics	N/A	Signant Health RTSM	Marken® email mailbox	Email	Event triggered

4. Testing Strategy and Governance Framework

4.1 The compliance Plan

To ensure strict adherence to compliance requirements spanning GoodxPractice (GxP), medical devices, mobile applications, CFR Part 11, risk management for business systems, digital health solutions, privacy regulations, digital security, records archival, healthcare compliance, general data protection regulations (GDPR), Health Insurance Portability and Accountability (HIPAA), and security protocols for external access and hosting, as well as medical device and data classification, we compiled a comprehensive compliance plan. The plan not only encompasses the framework for the user acceptance testing (UAT) and the Dry Run, it also outlines the documentation procedures for testing outcomes, risk assessments, the release process, associated documentation, activation of the technology package for productive use referred to as 'go live,' and the structured maintenance process. Furthermore, it delineates the procedures for handling change requests as well as bug fixes.

4.2 Testing Strategy

The primary objective of the UAT and the Dry Run was to verify that the technology package functions as intended and meets the business requirements before its deployment to production. An overview of the steps involved in the testing of the RADIAL technology package are summarized in the diagram below (Figure 2).

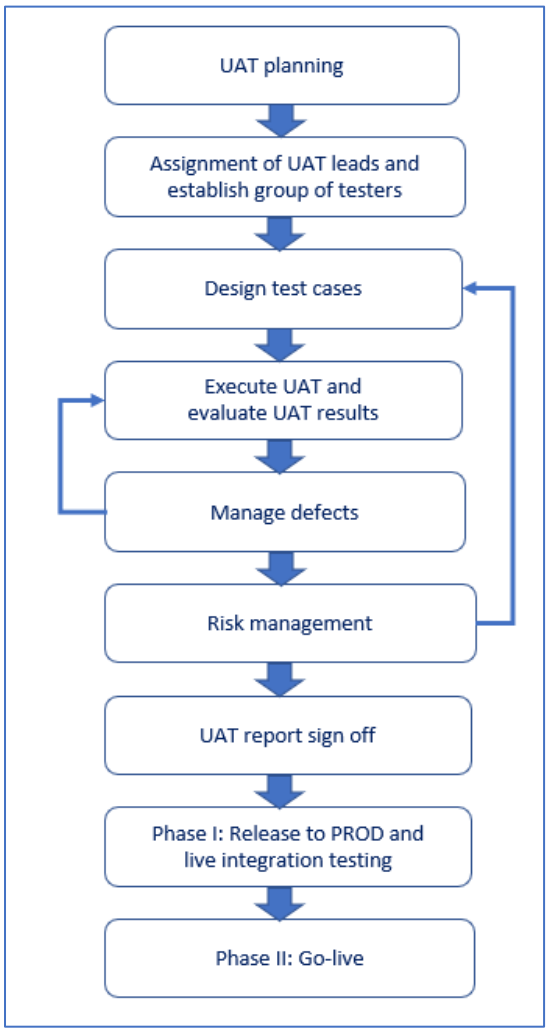


Figure 2. Diagram of the RADIAL testing process.
Note that the Dry Run is not shown.

4.3 UAT Planning

The UAT process presented a significant challenge owing to the complexities arising from the numerous components, integrations, and diverse participant workflows across the different arms. To tackle this, we opted for a systematic approach and divided the UAT process into smaller, more manageable segments (see Table 4). Segments were labeled as Efforts E1 to E9 and allowed us to focus on specific aspects of testing with precision, ensuring comprehensive coverage and reliability. A UAT Planning Tracker was created to summarize the testing requirements and all applicable technology involved in each of the efforts. Of note, Efforts E1 to E9 were not conducted sequentially by number but were carried out concurrently. Effort 10, i.e., the Dry Run, was scheduled to be conducted last as a final rehearsal before the actual deployment.

Table 4. The UAT segments referred to as Efforts

Effort Number	Description
E1	Workflows

Effort Number	Description
E2	CRF/Export/Rights and Roles/User Satisfaction
E3	Pre-Screener Website
E4	Informed Consent
E5	Glucometer
E6	MEMS
E7	RTSM
E8	Website for remote recruitment
E9	Splash, the Clinpal® eCRF Login Page
E10	Dry Run

4.4 UAT Leadership

As each of these ten efforts brought their own unique challenges and complexities, we recognized the need for accountability and streamlined management. To achieve this, we introduced a crucial element to our strategy – the appointment of designated UAT leads for each effort. The UAT leads played a crucial role in careful planning, preparing, coordinating, and executing the UAT within their designated areas of responsibility.

By assuming this role, the UAT leads acted as vital connectors, promoted effective communication, and reporting channels among testers, the core technology team, and the effort-relevant technology vendor(s). This approach not only strengthened our understanding of each effort's readiness but also fortified the overall reliability and robustness of our testing strategy and strengthened our confidence in the readiness of the systems as we progressed through the testing phases.

4.5 Test Cases

UAT Leads and Subject Matter Experts (SMEs) were responsible for preparing comprehensive test scripts, referred to as Testing Logs. Use cases and actors, as described in the specification process, served as the foundational basis for preparing the test steps. Each test step within the Testing Logs detailed the actions necessary to validate a defined use case, ensuring a systematic approach to testing.

To achieve clarity and traceability within each testing log, every test step was meticulously documented in sequential order. Test step descriptions offered a comprehensive outline of the exact interactions, inputs or operations required for effective execution. Furthermore, for efficient tracking and referencing, each test step received a unique identifier. This identifier consisted of the product release number, the test run number, the Test ID, and the Test Step number. The unique identifier was crucial in associating and organizing screenshots, particularly for those cases where test steps did not meet the specified criteria.

4.6 Tester Pool Formation and Training

A diverse pool of testers (no patients) was established and recruited from Trials@Home beneficiaries, bringing together individuals with varied skills and expertise. This approach offered flexibility in resource allocation, enabling testers to be assigned to specific testing efforts based on their availability and proficiency.

UAT testers were invited to participate in specific efforts from the UAT leads. As part of the onboarding process, the testers underwent comprehensive training, which included acquiring the necessary knowledge to effectively test the relevant technology component(s). Additionally, the training encompassed an understanding of the overarching UAT approach, along with guidelines for documentation and reporting of findings.

Upon successful completion of the training, testers were granted access to the relevant systems and were provided with the testing logs to start testing. Access to systems was tailored to each tester's specific role and responsibility.

4.7 UAT Execution

During the UAT, testers documented their progress, observations, and pertinent information within the designated Testing Log. This log served as a centralized repository for capturing and recording critical details throughout the UAT process.

For each test step, testers commenced the execution of predefined test procedures as outlined in the Testing Logs. In cases where a Testing Log was unavailable, testing was conducted against the provided specifications. It's important to note that the UAT was conducted within a testing environment provided by the vendor. Testers recorded the outcome of each test step as either "Pass" or "Fail." "Pass" indicated successful execution, while "Fail" signified encountered issues or failure. In instances of "Fail," testers were required to furnish the testing log with comprehensive comments, including relevant observations, explanations, or insights, to aid the development team in comprehending and, if necessary, reproducing the issue or failure. Additionally, screenshots were employed to document and report on failed steps.

Upon the completion of each UAT run, all failed steps underwent a comprehensive review and assessment conducted by the relevant UAT effort lead, tester(s), and the development team. Any valid findings or issues identified during the UAT process were addressed and incorporated into subsequent versions of the relevant technology component(s). This iterative process of review, resolution, and retesting continued until all findings with a high and medium risk assessment were satisfactorily resolved.

The iterative process of review, resolution, and retesting persisted until all findings with high and medium-risk assessments were satisfactorily resolved. Low-risk and/or no-risk items were also addressed, however,

as we approached the move to production timeline, immediate resolution of these items became impractical due to time constraints. These low-risk items were duly acknowledged and incorporated into the central change log for future attention and resolution.

4.8 The Dry Run

The dry run was initially planned to commence upon the successful conclusion of the UAT Efforts E1-E9. However, due to time constraints, it started earlier, but only after comprehensive testing had assured and UAT leads were confident in the overall stability and reliability of the technology package. During the dry run, we followed a general script, emphasizing the primary workflows of the involved end user roles, as opposed to replicating the detailed steps tested in the UAT. The chosen dry run testers (recruited from within the project) were intended to simulate real end users who would be experiencing the end-to-end system for the first time, as they had no prior involvement in the UAT process. This approach was designed to offer an unbiased perspective on the system's ease of use and overall user-friendliness.

Test steps that failed during the dry run were meticulously documented in the Dry Run Issues Tracker. Subsequently, the Dry Run team, UAT effort leads, and the developer team jointly reviewed findings and categorized them as either “bugs”, signifying misbehaving functionalities, or “changes”, representing updates or last-minute modifications to specifications required to allow for a smoother user experience.

To ensure that corrections and/or changes made did not introduce new issues, we adopted a regression testing approach. Given the technology package's stability at this stage, our regression testing efforts primarily targeted the areas most likely to be affected by the corrections and/or changes, guided by the developer team's insights. This approach meant that retesting concentrated on specific areas directly influenced by the correction and/or change, rather than encompassing the entire system unless explicitly instructed otherwise by the developers.

4.9 Risk Assessment

Unresolved findings from the UAT and/or Dry Run that exceeded the allocated timeframe for resolution, we conducted a risk assessment to determine the feasibility of proceeding with the move to production. Given that the study data is not submission relevant, we adopted a 'light' risk assessment approach. Our risk assessment approach aimed to identify which findings required immediate attention before the go-live and which ones could be deferred for later resolution. To facilitate this decision-making process, we employed a comprehensive risk table that summarized risk levels, along with corresponding descriptions and decisions based on the identified finding risk level.

Table 5 provides a concise overview of risk levels, accompanied by their respective descriptions and decisions.

Table 5. Risk assessment levels and associated decisions

Risk Level	Description and Decision	Examples
High	Issues that have a significant impact on critical functionality, user experience, or business operations. **Requires immediate attention and resolution before go-live.**	○ Application crashes or major system failures ○ Participant Safety ○ Critical security vulnerabilities ○ Non-compliance with regulatory requirements
Medium	Issues that have a noticeable impact on specific features or functionalities but may have workarounds or alternative approaches available. **Should be addressed as soon as possible but may not necessarily delay the go-live.**	○ Functionalities with intermittent errors or unexpected behavior ○ Performance degradation under specific conditions ○ Minor security vulnerabilities
Low	Issues that have a minimal impact on overall functionality, user experience, or business operations. **Shall be addressed in subsequent releases or maintenance cycles without delaying the go-live.**	○ Cosmetic issues or minor UI inconsistencies ○ Non-critical documentation errors ○ Low-impact performance optimizations
No Risk	Non-issue or false positive. **Finding can be closed, no further action required**.	○ UI/Layout adjustments ○ Typographical errors in non-critical sections ○ Glitches that occur rarely and do not hinder the usability or the functionality

4.10 UAT Outcome Review, Approval and Release to Production (phase I)

The documentation generated during the UAT encompassed a crucial set of records, including carefully executed and thoroughly reviewed testing logs, as well as comprehensive Issue logs documenting identified issues and their resolutions. At that point, only open findings with low risk were permitted to remain unresolved. Following the completion of the comprehensive risk assessment process, a concise yet comprehensive UAT summary report and production release (phase I) was prepared by the validation lead. The report served as a consolidated account of the UAT outcomes, providing a clear depiction of the UAT scope, the outstanding items along with their associated risk assessments, as well as justifications for any deviations reported or observed during the UAT. Furthermore, it included a list of the technology components tested and highlighted the specific components, along with their details (version, build, etc.), ready to be migrated to the production environment.

The UAT summary report underwent a thorough review and approval process by all UAT leads to verify the accuracy of the referenced documentation and, consequently, to affirm the completion of all testing activities. In the next step, the report was sent for review and approval to the relevant stakeholders, including the Tech package lead, CRO, sponsor, and vendor representatives. Their approval signified the green light for releasing the tech package into production. The comprehensive documentation and review process ensured that the UAT was conducted systematically and rigorously, with appropriate oversight, guaranteeing a smooth transition to the production phase.

The outputs delivered as part of the completed UAT (Phase I and Phase II) are listed below in Table 6.

Table 6. Deliverables of Phase I and Phase II activities

UAT Outputs (Phase I)	**Description**
Executed Testing Logs	Executed Testing Logs document all testing activities, including test cases executed, results, and any observations or issues encountered during the testing phase.
Completed Issues Logs	Completed issues logs capture identified issues or defects during the testing phase as well as a risk assessment for any items that remain open at go-live.
Compliance Summary Report (UAT) & Production Release (Phase I) Sign Off	The compliance report summarizes the testing results, issues resolution, and deviations during testing. It also includes the signatures of UAT leads to signify UAT completion. As the approval to move to production will be a phased approach, this report serves as the initial confirmation for the release of the technology package to the production environment. At this point the released technology package underwent testing of live connections and integrations.
Testing Output (Phase II)	**Description**
Go-Live Confirmation (Phase II) Sign Off	Upon successful completion of Phase I the technology package will receive authorization for operational use in the production environment. This milestone is marked by the completion of the Go-Live Confirmation (Phase II) form.

4.11 Production testing and Go-Live (phase II)

To ensure a seamless and successful transition during the deployment phase, our approach consisted of two phases.

Phase 1: Testing of Live Connections and Integrations in the Production Environment

Several days before the official go-live date, we initiated the migration of the eCH system to the production environment. This early migration enabled the eCH team to carry out comprehensive testing of live connections and integrations. During this testing phase, we enforced the following measures:

- **Exclusive Access for Authorized eCH Engineers:** Access to the production environment was granted solely to authorized eCH engineers. Their access was exclusively dedicated to conducting connectivity and integration testing.
- **Restricted User Account Access:** To maintain the highest level of control, user account access was not extended to any non-eCH personnel during this period.

Phase 2: Official Go-Live and User Access Provision

Upon eCH confirmation of operational readiness, the official go-live stage commenced. The validation lead prepared the Go-Live Confirmation (Phase II) Sign Off and shared with the key representatives for approval. Once the sign-off was complete, all approved users were granted access to the production environment.

4.12 Post Phase I and post Go-Live Changes & Updates

Changes or issues identified during phase I were assessed and categorized based on their nature. These assessments determined whether they were classified as bug fixes or change requests. Bug fixes typically pertain to issues that need to be addressed to ensure the system's functionality and performance were in line with expectations, while change requests refer to modifications or enhancements needed to improve or enhance any component of the technology package.

Figure 3 encapsulates the entire process flow, providing a visual roadmap for achieving a well-organized project execution. It highlights the critical components, beginning with the initial requirements and specifications, progressing through the rigorous User Acceptance Testing phase, navigating through the release phases, and finally, demonstrating how change requests are expected to be handled throughout the technology package's lifecycle.

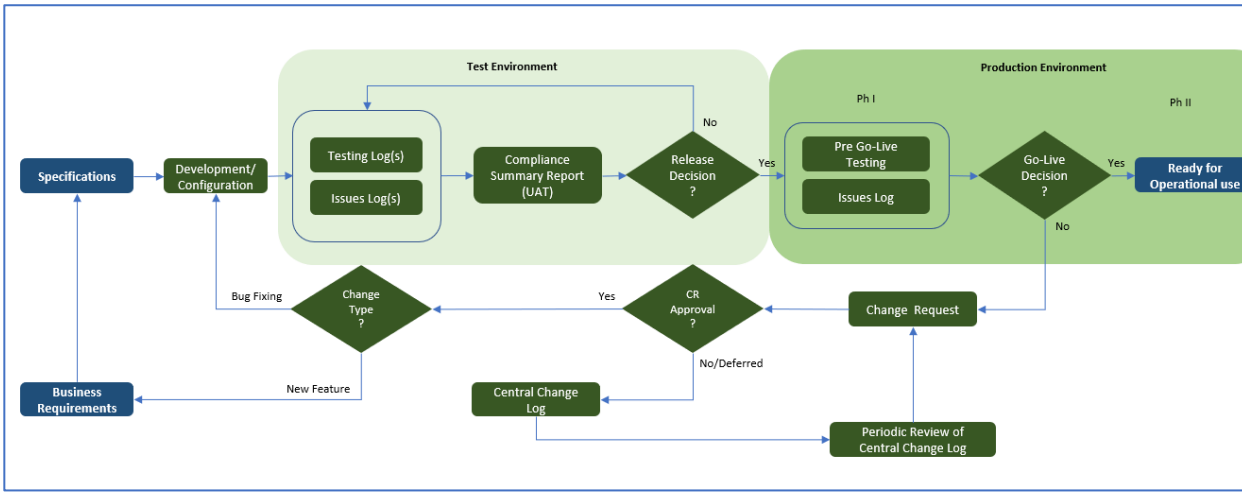


Figure 3. Process Flow Diagram: Specifications, UAT, Release (Phase I and Phase II), and Change Requests

4.13 The Governance Charter

To establish effective governance over technology package maintenance, updates, and the staggered release approach by country, we formulated a comprehensive governance charter and assembled a dedicated governance team. This team plays a pivotal role in overseeing various aspects, including the evaluation of user reported tickets, identifying areas for improvement, and monitoring third-party technology vendors to ensure compliance and optimal performance. Furthermore, the governance team actively collaborates in decision-making processes and provides critical insights to uphold the integrity and efficiency of our technological ecosystem.

5 References

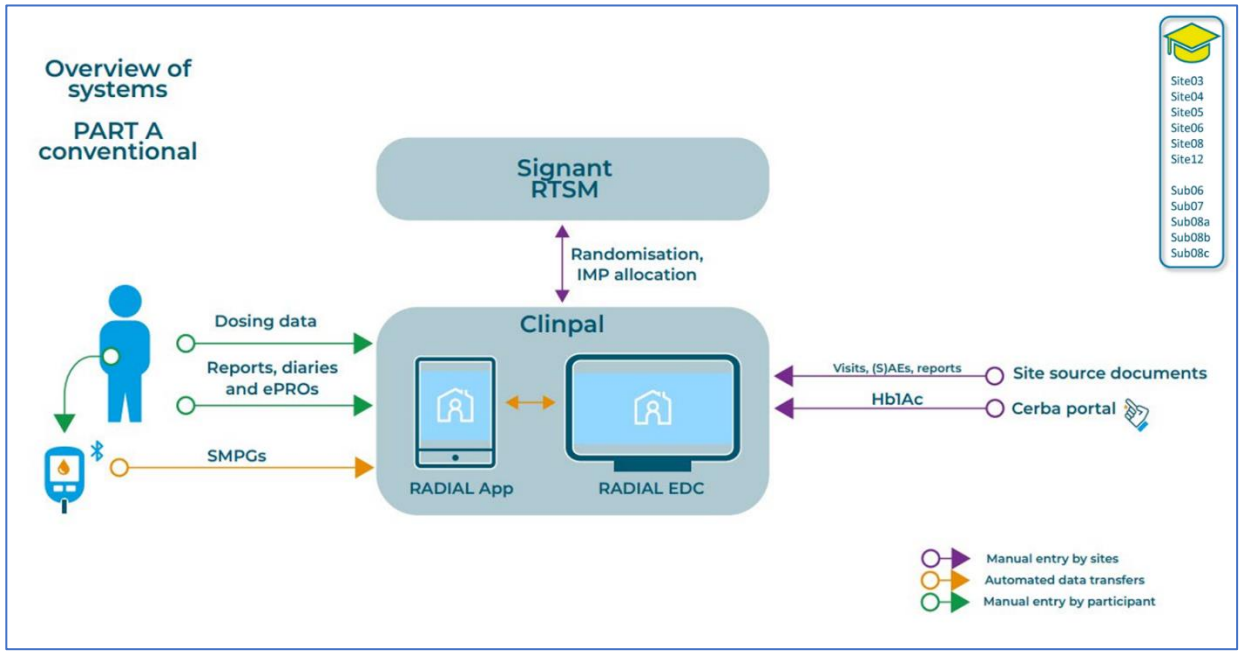
Ref No.	Title	Document
R01	Compliance Plan	RADIAL_Compliance_Plan_V2.0_27JUN2023
R02	Governance Charter	RADIAL_Technology_Governance_Council_Charter_V1.0_06JUL2023

6 Abbreviations

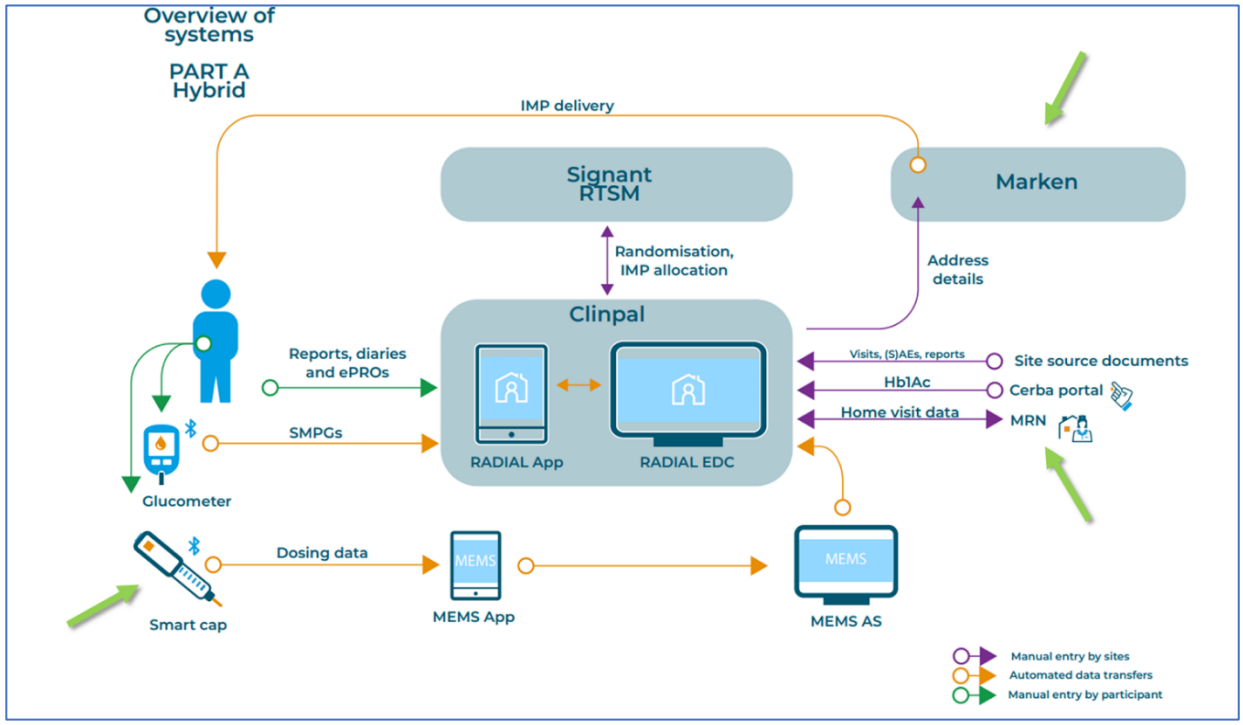
Title	Document
BYOD	Bring Your Own Device
HCP	healthcare professionals
UAT	User Acceptance Testing

7 Appendix

7.1 PART A – Arm 1 - conventional



7.2 PART A – Arm 2 - hybrid



7.3 PART B – Arm 3 - decentralized