

Title of Project

Development of an electronic study management system

Abstract

Clinical trials are traditionally very paper-heavy; however, there has been a recent shift toward electronic trial management solutions. At the Bristol Trials Centre (BTC), a bespoke in-house system was developed in response to this. Using the experiences gained from developing this in-house system, the BTC and collaborators across the CTU network set out to design and develop a generic electronic trial management system (named MANGO).

Informed by feedback from trial management professionals, the MANGO project group developed a functional specification describing the system requirements. These were broken down into components and developed following 'Agile' methodology, using Atlassian Jira Software. A test system was created, and testing conducted by the BTC development and operations teams. The initial elements for development were the overall system architecture, delegation log, training log and key study details. A live version of the MANGO system was then made available for BTC trial staff, with 12 trials currently active. The next core elements for development are the Trial Master File (TMF) and Investigator Site File (ISF).

The next step for the project is to create a MANGO test system for external CTUs (launch set for late September 2023). Once the TMF and ISF functions have been developed, a live version of MANGO will then be made available to all CTUs.

Throughout the project, the team have actively engaged with the trial management community. Once a timeline is set for the live external system, dissemination activities will take place via project collaborators, CTU and trial management networks, and online activities.

Introduction

Clinical trial regulations and Good Clinical Practice (GCP) mandate that extensive records are maintained for trials, including delegation logs, Trial Master Files (TMFs) and Investigator Site Files (ISFs). This has resulted in trials being very paper-heavy. However in recent years there has been a shift to electronic solutions, accelerated by the shift to home working during the COVID-19 pandemic, with the intention to reduce both the environmental impact of trials and the required storage space.

Electronic document storage can increase efficiency at Clinical Trial Units (CTUs) by (i) reducing the need for printing, filing and posting paper documents, (ii) removing duplication between the TMF and ISFs, and (iii) allowing remote monitoring of ISFs, so reducing time and money spent on in-person site visits. Electronic solutions can also reduce the environmental impact of trials¹.

In response to this shift, many CTUs have adopted their own electronic trial management systems, for example using shared drive folders. At the Bristol Trials Centre (BTC), an in-house designed trial management system was developed and used to manage a variety of trials. This system included the TMF, ISFs and an electronic delegation log. However, the system was bespoke to each trial, placing a large burden on the development team. The additional development time was also not accurately costed in grant proposals as the resources needed were hard to predict.

We know that there is national interest from Trial Managers and CTUs for an electronic trial management system. An abstract describing the BTCs bespoke trial management system, the range of trials using the system and its acceptability to staff at participating sites was chosen for presentation at the 2019 UK Trial Managers Network (UKTMN) annual conference. Following this presentation, staff from 15 UK CTUs contacted the BTC team to express an interest in learning more about their trial management system. A national survey of Trial Managers by the UKCRC Trial Management Operations group found that availability and use of electronic TMFs was one of the most highly cited areas for improvement.

Using the experiences gained at the BTC, and with the knowledge that this was in demand from the trial management community, we set out to develop a generic electronic trial management system. The ambition was for the system to incorporate the TMF, ISFs, and delegation log, with the aim to streamline central coordination of studies by CTUs, including Clinical Trials of Investigational Medicinal Products and Device trials.

Methods

System development

Design and development of the electronic trial management system, a project named MANGO, was led by the BTC in collaboration with a team across the CTU network.

A functional specification was produced by the BTC and reviewed by the project collaborators throughout 2021 and 2022. This document described the system requirements broken down by its components; overall system architecture, user registration, user account management, home screen, key study details, participating sites, user study access & delegation log, training logs, study user account management, TMF, ISF, system workflows. The collaborators also considered future system functionalities, including linkage to trial participant databases and production of financial reports.

As well as input from the project collaborators, the design of the system was informed by results of a previous survey of site staff using the bespoke BTC trial management system; these included the use of one password to access the whole MANGO system and inclusion of training logs. Another key aspect was to negate the need for extensive system training materials – instead, prompts and information were to be included within MANGO.

The development followed an ‘agile’ methodology^{2, 3}. Once agreed, the system requirements were broken down into individual tasks. The BTC team chose to use the Atlassian Jira Software (© 2002 - 2023 Atlassian Corporation Pty Ltd.) to plan and track the development process. This system allows tasks to be allocated to themes and grouped in to “Sprints” which are linked to system update releases. An initial web-based test system was developed and screenshots shared with collaborators and the wider trial management community.

Testing was conducted by the BTC database development team and members of the BTC operations team. This was to ensure that each function was acting as designed. More extensive user testing was then completed by using the system for real in a range of BTC led trials. Any issues and areas for improvement were fed back to the development team; these were triaged and prioritised for development and system update as part of the next Sprint release.

Using the MANGO system

To use MANGO, trial management staff within CTUs will register for an account for the MANGO system and create studies. All studies have a core set of study fields associated with them (for example, contract start and end dates, name of funder and reference, regulatory approval dates, names and roles of key study team members) which should be completed. Individual study records can be customised with their logo and colour of choice. CTUs can choose to simply use this aspect of MANGO for Quality Assurance/Portfolio management purposes.

Within each study, there are a number of additional aspects which can be set up. These include; delegation log tasks, site names and types, user roles (including associated tasks and sites) and registration fields (including CV and GCP upload, and trial-specific training information).

Staff at sites participating in those studies (“users”) can then create a MANGO account, which gives them access to a Home screen and the ability to request access to any study within the CTU. The study access request (registration) process collects the information required to populate the electronic delegation log for that study, including the users site, start and end dates, role and tasks to be performed. Users can also be asked to upload their current CV and GCP certificate, and any other required study documentation. Depending on the user role, following checking of the study access request by the CTU trial team, user study access will either be approved by the CTU trial staff or by the Principal Investigator at their site (Check and Approve model). Once approved, the user is then able to work on the study.

Users can request access to multiple studies being run within the same CTU, but will have to complete separate study access requests. It is possible for users to re-use previously uploaded documents, e.g. GCP certificate.

During development, the BTC continued to update and engage with the trial management community – the Program Manager presented a webinar on behalf of the Trials Methodology Research Partnership (TMRP) in 2020, presented at the UKTMN Rapid Presentation Event in 2020 and again at the UKTMN conference in 2021.

Results and Conclusion

The MANGO system is live and being used by trial staff within the BTC, with 12 studies active across a variety of clinical settings and trial designs. BTC users have formed a local user group, which meets on a regular basis and maintains ongoing communication via Microsoft Teams. The BTC user group have developed a brief 4-page set up checklist, guiding BTC trial staff through registration and study creation, and a 2-page registration guide for site users.

Engagement with and feedback from the user group is informing an ongoing process of development and improvement of the system, which is on a constant 3-weekly cycle of “Sprint” development through Jira. There is also a helpdesk through which BTC users can report issues. The initial focus for development has been on the overall system architecture, delegation log, training log and key study details. The next core elements for development will be the TMF and ISFs.

As well as the live system, BTC users have access to a test system where they can try out the functionality before adding their study to the live MANGO system. A second test system will soon be made available to external CTU trial users (<https://btc-u.bristol.ac.uk/MangoExternal/>), with a launch meeting scheduled for late-September 2023. These users will include the original collaborators and a number of other CTUs who have expressed interest throughout the timeline of the project. The feedback from these external users will likely result in further development and improvement cycles.

Once the TMF and ISF elements have been completed and rigorously tested, a live version of MANGO will be made available to all UK CTUs. Prior to release, we will work with our development team, BTC management and collaborators to agree a costing model. The expectation is for a set-up fee and small ongoing fee, to cover costs associated with ongoing system development, servers and CTU trial user support (provided by the BTC). As developments will also be utilised by trials within the BTC, some of the ongoing work will be covered by research grants for BTC trials which are planning to use the MANGO system.

Trial staff at CTUs will provide basic training and ongoing support to their site users. All users (trial staff and sites) will also have access to a helpdesk system to report errors/issues and submit requests, which will be managed by the BTC.

We continue to receive ongoing interest in the project, with multiple CTUs keen to adopt MANGO as soon as possible. There is still no unified approach to electronic trial management across CTUs and very few available systems. Any existing products are “off the shelf”, whereas MANGO is a user-guided bespoke system, allowing for customisation to fit the requirements of any CTU and any trial, without the requirement for extensive training or programming knowledge. MANGO is a long-awaited tool for the trial management profession and we hope for widespread adoption across the network.

Dissemination

The external CTU test system will be launched in late-September 2023, with access provided to collaborating organisations and other interested CTUs. Their feedback will inform ongoing development of the existing live system.

Once a firm timeline has been set for making a live system available to all CTUs, we will disseminate this information via our collaborators, the UKCRC CTU Directors, the UKTMN, trial management and methodology networks, and with online activities such as promotion through social media. We also aim to write up the development process for publication.

The live MANGO system will be made available to all CTUs – we intend to complete this by Q4 2023/Q1 2024. Development will be an ongoing process, with future medium-term goals including linkage to trial participant databases and addition of multi-factor authentication.

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Conflict of interest declaration

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Appendices

JIRA Release Notes

1.0 First release of live version.
27/07/2022

1.1 Some bug fixes and new screen for registration study user fields.
03/08/2022

1.2 MANGO Sprint 4:

MANGO-189 Fix of bug in acronym field

MANGO-188 Addition of info box to Site Fields and Study Fields

MANGO-186 Addition of document validation rules

MANGO-184 Creation of My Details section in left-hand menu

MANGO-183 Addition of new error screen to replace asp.net page

MANGO-182 Fix to display for number of sites in a study

MANGO-181 Fix to error when editing some study sites

MANGO-180 Fix to error where Delete button not always showing

MANGO-179 Fix to error allowing site to be added to a study multiple times

MANGO-178 Fix to bug where Edit link leading to broken page

MANGO-177 Fix to bug where search parameters cannot be cleared

MANGO-176 Change to workflow for creating new sites

MANGO-175 Fix to bug where sites cannot be added to second (or later) pagination pages

MANGO-174 Addition of user fields validation

MANGO-168 Fix to wording error on Create List Item page

MANGO-167 Field notifications to be deleted when study field deleted

MANGO-166 Addition of function to export delegation log

MANGO-165 Notifications on home screen

MANGO-164 Set up sending notification emails

MANGO-163 Fix to error when unlocking user

MANGO-156 Remove delete button from study list

MANGO-108 Fix to ensure items cannot be deleted if they are linked to other objects

MANGO-96 Users can administer their own MANGO accounts

MANGO-43 Set up user fields used in studies

MANGO-42 Set up user study access workflow

MANGO-41 Addition of read-only Inspector role

MANGO-31 Allow study fields to be filled or edited by system users

MANGO-18 System to be capable to supporting large multi-centre studies (100+ sites)

MANGO-8 Audit trail for user registration process

MANGO-4 System to be compatible with computers, tablets and mobile phones
07/09/2022

1.3 MANGO Sprint 5:

MANGO-220 Add message to ensure user wants to dismiss notification

MANGO-215 Traffic light on delegation log fixed

MANGO-214 Patient Database renamed to Participant Database

MANGO-211 Info box added to Study User Role to explain how to name roles
MANGO-210 Fix to bug on User Fields
MANGO-209 Search and sort added to Maintain Fields for user, study and site fields
MANGO-208 Read only list of tasks added to bottom of delegation log
MANGO-207 Allow delegation log searching by username and email
MANGO-206 Fix to user role missing 'Request access' button
MANGO-203 Fix to error when creating delegation log task
MANGO-202 Fix to bug, changes to site in one study linking to other studies
MANGO-198 Allow delegation log filtering and sorting by any column
MANGO-196 Fix to delegation log allowing same number to be used twice
MANGO-195 Fix to errors on Maintain Sites section
MANGO-193 Addition of info box to Edit Site Template
MANGO-192 MANGO icon added to website tab
MANGO-191 All IDs in URLs now encrypted
MANGO-190 Fix to Study User Field scrolling
MANGO-188 Addition of info box to Site Fields and Study Fields
MANGO-186 Addition of document validation rules
MANGO-183 Addition of new error screen to replace asp.net page
MANGO-173 Set up of user field notifications
MANGO-167 Field notifications to be deleted when study field deleted
MANGO-165 Notifications on home screen
MANGO-164 Set up sending notification emails
MANGO-160 Study roles now linked to patient database function tasks
MANGO-159 Users can add database function tasks to system
MANGO-96 Users can administer their own MANGO accounts
MANGO-43 Set up user fields used in studies
MANGO-42 Set up user study access workflow
MANGO-8 Audit trail for user registration process
MANGO-4 System to be compatible with computers, tablets and mobile phones
26/10/2022

1.4 MANGO Sprint 6:

MANGO-245 Settings
MANGO-244 Site field list not correct
MANGO-238 Creating Study Field notification will not allow correct number of days prior to date
MANGO-225 On Studies (Main) page the Delegation log display doesn't fit smaller screens
MANGO-218 Filter Maintain study list by access like User study list
MANGO-215 tbStudiesMain/Details Delegation Log Display
MANGO-210 User Fields Bug
MANGO-209 Maintain Field Definitions needs search and sort
MANGO-208 Delegation Log: List of tasks
MANGO-204 On Study Role, implement Users Currently In This Role
MANGO-183 Error screen
MANGO-66 Email from Delegation Log
MANGO-64 View Study Delegation Log
07/12/2022

1.5 MANGO Sprint 7:

MANGO-3 The system needs to be secure, with patient identifiable data password protected.
MANGO-68 Delegation Log End Date Remove Access
MANGO-69 Study access: Notifications and Home Screen
MANGO-137 At registration, add new users to User role automatically
MANGO-164 Sending notifications
MANGO-165 Show notifications on home screen
MANGO-173 User field notifications
MANGO-217 Access to newly created study
MANGO-220 Actioning Notifications
MANGO-222 Forgotten Password: Check that link expires after 1 day
MANGO-226 Check and Approve Newly Registered Study Users
MANGO-234 Deleting Notifications
MANGO-235 Admin / User table search/filter
MANGO-237 Error when navigating to second page of notifications
MANGO-240 Add emails to tbEmail (eg Notifications)
MANGO-242 Study registration emails
MANGO-247 Sites in Users/Studies need to be filtered by ones you have access to
MANGO-250 When editing study details date fields, calendar disappears under the title banner if it's the first in the list
MANGO-253 Remove owner field from tbStudy
MANGO-255 Sorting not working on tbNotificationStudyUserFields
MANGO-256 Field label layouts on tbNotificationStudyUserFields
MANGO-262 Bug in AdminController
MANGO-265 Check Register Detail page - confirmation not working
MANGO-266 Receiving "Something went wrong" message when trying to confirm registration check
02/02/2023

1.6 MANGO Sprint 8:

MANGO-268 Bug: Live user registration field not required when set to required
MANGO-267 Bug: Can't upload document to user document field
MANGO-261 Bug: Date issue in Admin - Edit User
MANGO-258 Email Subjects can now be set in settings for the whole app
MANGO-221 Notifications on Home screen: Add paging
MANGO-213 Delegation Log Template can be saved and loaded
MANGO-140 Study and site fields can only be edited by users in the correct study role
MANGO-98 Delegation Log: View User Details
27/02/2023

1.7 MANGO Sprint 9:

MANGO-281 BUG Fixed error when cancelling registration on first screen
MANGO-280 New info box on Maintain Study fields page
MANGO-279 Add Section, Name and Number to Delegation Log tasks
MANGO-278 First user start date, must be in past or current date
MANGO-277 Changes to layout of Site Details page
MANGO-276 Changes to layout of Study Details page
MANGO-271 New optional Study fields: Email and URL
MANGO-260 Addition of button to disable an approved study user

MANGO-257 Addition of new Study Role Tasks
MANGO-59 Site staff can view Delegation Log for their site
MANGO-40 Parent roles at sites
17/03/2023

1.8 MANGO Sprint 10:

MANGO-305 Delegation log start date can be either in the past or current date
MANGO-304 Bug fix: Error when requesting access to studies
MANGO-303 Bug Fix: Copy emails to clipboard from delegation log not working
MANGO-283 Paging added for 'User currently in this role' in role admin
MANGO-95 Users able to maintain their own delegation log record, e.g. change of tasks, amending dates
17/04/2023

1.9 MANGO Sprint 11:

MANGO-307 Bug fix: Error when discarding requests on "Request access to another study" page
MANGO-296 Addition of reason for access request rejection to automatic email to user
MANGO-282 Addition of ability to allocate user to a role (Admin, Elevated, User) during approval of user MANGO registration
MANGO-270 "My Studies" list now searchable by name and status
MANGO-269 User field can now be added to more than one user role at once
MANGO-264 Section of delegation log tasks can now be added to a user role at once
MANGO-216 Delegation log can be downloaded as image (.png) or Excel file (.csv), at both a study and site level
09/05/2023

1.10 MANGO Sprint 12:

MANGO-312 All options in drop down lists now sorted alphabetically
MANGO-287 Clearer flagging of test vs live system (TEST banner over MANGO logo)
MANGO-200 Ability to Disable a user added to 'Edit User' page (Admin role access only)
MANGO-316 Bug fix: Error on Maintain Users page 5 now corrected
MANGO-310 Addition of 'Back to User List' button at end of Activate User page
MANGO-272 Read-only list of 'child roles' (those which can be checked/approved by a role) added to Edit Role page
MANGO-308 When new site added to a study, it will be automatically added as an Available site for all user roles in that study
MANGO-241 Study field 'Contract End Date' set as default value for 'End Date' when requesting access to a study
MANGO-286 Changes made to wording of automated emails sent during MANGO registration process
MANGO-309 Changes made to wording on screen during forgotten password process
MANGO-306 Character limit on User Fields, Site Fields and Study Fields extended to 100 characters

MANGO-263 In Admin – Users, added ability to view user account (including uploaded documents) and to copy email addresses to clipboard
MANGO-284 Email addresses used for registration must be unique
02/06/2023

1.11 MANGO Sprint 13:

MANGO-298 User end date will auto-populate any study delegation log end dates. Users will be notified 1 month prior to their study delegation log end date
MANGO-239 Study registrations can be saved as 'In Progress' and resumed at a later date
MANGO-315 Correction to typo when exporting delegation log
MANGO-324 Renaming and relocation of button to request access to a study
MANGO-48 Full audit log of any changes made by a user to their study access
04/07/2023

1.12 MANGO Sprint 14:

MANGO-273 Warning added if all parent roles are removed from a role (i.e. no roles able to approve that role)
MANGO-320 Bug: Some studies not displaying correctly in study list within Maintain Studies
MANGO-318 After rejecting user registration to a study, study team will be able to see the date of and reason for rejection. Also, study team able to see date study account registration checked to see how long waiting for approval
MANGO-319 Updates to message displayed after user registers for a MANGO account
21/07/2023