ISRCTN10382623 https://doi.org/10.1186/ISRCTN10382623

Can we use artificial intelligence tools for automatic analysis of bone marrow samples?

Submission date	Recruitment status	[X] Prospectively registered
24/11/2020	No longer recruiting	[ ] Protocol
Registration date	**Overall study status**	[ ] Statistical analysis plan
11/12/2020	Completed	[X] Results
Last Edited	**Condition category**	[ ] Individual participant data
13/04/2022	Other	

Plain English summary of protocol

Background and study aims
Optical microscopy remains the gold standard technique for diagnosing several tens of pathologies by manually reviewing samples under a microscope. Microscopic examination and classification of cells that form blood cells is a critical step for the diagnosis of blood diseases. However, it is a laborious, time-consuming technique and its results are subject to the expert examining the sample. Bone marrow aspiration (BMA) biopsies are carried out in order to diagnose many blood diseases, such as leukaemia.
This study aims to prove that the proposed digital solution will reduce time, costs and distances of microscopy diagnosis. To do so, we are generating a correctly annotated database that can be used to train Artificial Intelligence models that will help in blood disease diagnosis.

Who can participate?
Subjects with suspected hematological diseases attending 12 Octubre Hospital for a BMA procedure who are willing to provide a bone marrow sample. Also, professional hematologists who are expert at analyzing the bone marrow samples will participate.

What does the study involve?
Patients will provide a bone marrow sample that will be analysed using the AI system and also by a number of experts. The agreement between the expert analysis will be measured. Also the experts will fill in questionnaires assessing their satisfaction with the AI system.

What are the possible benefits and risks of participating?
None

Where is the study run from?
Hospital Universitario 12 de Octubre (Spain)

When is the study starting and how long is it expected to run for?
November 2020 to May 2022

Who is funding the study?
European Union Horizon 2020

Who is the main contact?
Dr María Linares (scientific), mlinares@ucm.es
Elisa Álamo García-Donas (public), elisa@spotlab.org

Contact information

Type(s)
Scientific

Contact name
Dr María Linares Gómez

ORCID ID
http://orcid.org/0000-0003-3180-6560

Contact details
Paseo de Juan XXIII, 36B
Madrid
Spain
28040
+34 686598450
mlinares@ucm.es

Type(s)
Public

Contact name
Miss Elisa Álamo García-Donas

Contact details
Paseo de Juan XXIII, 36B
Madrid
Spain
28040
+34 675574488
elisa@spotlab.org

Additional identifiers

EudraCT/CTIS number
Nil known

IRAS number

ClinicalTrials.gov number
Nil known

Secondary identifying numbers
v2.0

Study information

Scientific Title
Evaluation of a digital ecosystem leveraging mobile technology and artificial intelligence for digitalization and remote analysis of bone marrow samples

Acronym
MEDUL-AI

Study objectives
The proposed system will convert the current microscopes into digital microscopes connected to a comprehensive cloud platform that will enable images of BMA samples to be archived securely for remote review and clinical management. The possibility of a standardized digitalization of microscopy smears dramatically enhances diagnosis capabilities, as it enables remote diagnosis, second clinical opinion consultations, and helps to achieve automatization of the procedure as it serves as a way of gathering data to develop artificial intelligence tools that will ease the diagnosis process.

Ethics approval required
Old ethics approval format

Ethics approval(s)
Approved 12/11/2020 Ethics Committee of Clinical Research Hospital Universitario 12 de Octubre (Av. de Córdoba s/n 28041 Madrid, Spain; +34 91 7792613; maria.ugalde@salud.madrid.org), ref: CEIm: 20/430

Study design
Single center observational

Primary study design
Observational

Secondary study design
Cross sectional study

Study setting(s)
Hospital

Study type(s)
Diagnostic

Participant information sheet
See additional file (in Spanish)

Health condition(s) or problem(s) studied
Training of convolutional neural network algorithms for identification and counting of cellular lineages and specific cell types of bone marrow

Interventions

This is a one-centre, observational study to evaluate benefits of digitalization of collected BM samples in Hospital Universitario 12 Octubre from patients with suspected hematological disease. Generated data will be used to train convolutional neural network algorithms for identification and counting of cellular lineages and specific cell types of bone marrow.

The samples will belong to patients visiting the hematology outpatient clinic for a BMA procedure at Hospital Universitario 12 Octubre (Madrid).
The execution of the study consists of 2 phases:
Phase 1: Digitalization of routine procedure for BMA analysis of Hospital 12 de Octubre, and generation of BMA tagged image database for AI algorithm development.
Phase 2: Integration and evaluation of AI model as a tool for assisting hematologists in cell counting of BMA samples.

Intervention Type
Device

Phase
Not Applicable

Primary outcome measure
1. Number of samples analysed by web platform (TeleSpot) and analysis time per sample
2. Professionals' satisfaction measured with the new system measured by a usability report based on the results from a system usability scale (SUS) and AdaptaSpot Usability Questionnaire evaluating the remote analysis process. The SUS and the product questionnaires are completed every three months during the length of the study

Secondary outcome measures
1. Number of digitized bone marrow aspirate images correctly marked and tagged
2. Accuracy of the AI algorithm developed and the % of agreement among experts and AI algorithm. Cell-type classification performance will be tested by assessing the prediction quality of the algorithm in the validation set compared to the ground truth annotated by the specialist during the labelling phase.

Overall study start date
12/11/2020

Completion date
30/05/2022

Eligibility

Key inclusion criteria
Patients:
1. Suspected hematological disease
2. Signed informed consent

Bone marrow samples:
1. Good quality BMA sample (with proper staining and lump to provide sufficient quality and quantity)

Professionals/experts:
1. Sanitary professionals of the National Health System (Doctors, Cytologists) working at Hematology Department of the Hospital Universitario 12 Octubre with microscopy experience on hematological diseases

Participant type(s)
Patient

Age group
Adult

Sex
Both

Target number of participants
Assuming the hospital performs 25 BMA procedures a week, and as the data collection period is 10 months long, around 1,000 BMA samples will be eligible to participate in the study. We expect to digitize at least 150 BMA samples during the whole study

Key exclusion criteria
Patients:
1. Individuals unwilling to participate in the study
2. Unspecified reasons that, in the opinion of the investigator or sponsor, make the subject unsuitable for enrollment

Bone marrow samples:
1. BMA samples that do not have a good quality stain
2. BMA samples with insufficient lump

Date of first enrolment
17/05/2021

Date of final enrolment
31/03/2022

Locations

Countries of recruitment
Spain

Study participating centre
Hospital Universitario 12 de Octubre
Av. de Córdoba s/n
Madrid
Spain
28041

Study participating centre
SpotLab S.L.
Paseo de Juan XXIII, 36B
Madrid
Spain
28040

Sponsor information

Organisation
SpotLab S.L.

Sponsor details
Paseo de Juan XXIII, 36B
Madrid
Spain
28040
+34 916256927
elisa@spotlab.org

Sponsor type
Industry

Website
http://www.spotlab.org

Funder(s)

Funder type
Government

Funder Name
Horizon 2020 (grant no. 881062)

Alternative Name(s)
EU Framework Programme for Research and Innovation, Horizon 2020 - Research and Innovation Framework Programme, European Union Framework Programme for Research and Innovation

Funding Body Type
Government organisation

Funding Body Subtype
National government

Location

Results and Publications

Publication and dissemination plan

Any public disclosure including press releases, professional meetings, written publications, oral presentations, marketing purposes or similar shall be subject to the mutual approval of the Parties, and approval shall not be unreasonably withheld or delayed. Any written disclosure will be sent to the Parties within 20 days prior of its publication for review.
The results will be made public within 24 months of reaching the end of the study. The end of the study is the time point at which the last data items are to be reported, or after the outcome data are sufficiently mature for analysis, as defined in the section on Sample Size, Accrual Rate and Study Duration. If a report is to be published in a peer-reviewed journal, that initial release may be an abstract that meets the requirements of the International Committee of Medical Journal Editors. A full report of the outcomes should be made public no later than three (3) years after the end of the study.

Intention to publish date

01/05/2023

Individual participant data (IPD) sharing plan

The current data sharing plans for this study are unknown and will be available at a later date.

IPD sharing plan summary

Data sharing statement to be made available at a later date

Study outputs

Output type	Details	Date created	Date added	Peer reviewed?	Patient-facing?
Basic results		13/04/2022	13/04/2022	No	No