Undiscovered European AI biotech company Aladdin Healthcare Technologies continues to build novel technologies and achieve new milestones to combat age-related disease

Aladdin Healthcare Technologies – combining science and AI for breakthroughs in age-related disease

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Aladdin Healthcare Technologies is based in London, UK, and has assembled some of the world's leading AI engineers, scientists, biologists, and innovators. The company was founded as a response to the moderate progress that has been made to combat age-related diseases such as Alzheimer's, Parkinson's, cardiovascular diseases, and prostate cancer.

The company's mission is to transform the drug discovery and diagnosis process by developing game changing technologies and approaches that deliver superior results much faster and that are more cost-effective than traditional routes in an effort to move age-related healthcare and medicine to a superior level.

Using machine learning and artificial intelligence, combined with multimodal data, Aladdin has succeeded in building a platform for the early diagnosis of Alzheimer's disease and COVID-19, surpassing the clinical practice accuracy for early diagnosis.

Aladdin's team and AI awards and publications

Aladdin's AI team consists of senior members with successful commercial product experience and backgrounds from Oxford University, Imperial College, Cambridge University, and the Karolinska Institute. The team has won more than 30 global AI competitions, including ACM, IEEE, and Data Science Bowl 2019, with two of the Kaggle Grand Masters who rank top 100 in Kaggle Community (Kaggle is the largest and eminent data science community, with more than 1.3 million data scientists globally.)

Our solutions have achieved 30+ AI awards, including the following:

- ACM KDD CUP 2018 A.I Contest (1st place);
- Digital China Innovation Contest Grand Final, DCIC 2019 (1st place);
- China Innovation and Creativity Competition (ICC) 2018 (1st place);
- 2018 CCF Big Data & Computational Intelligence Contest (1st place); and
- 2018 Meinian OneHealth Hypertension Prediction Contest (1st place).
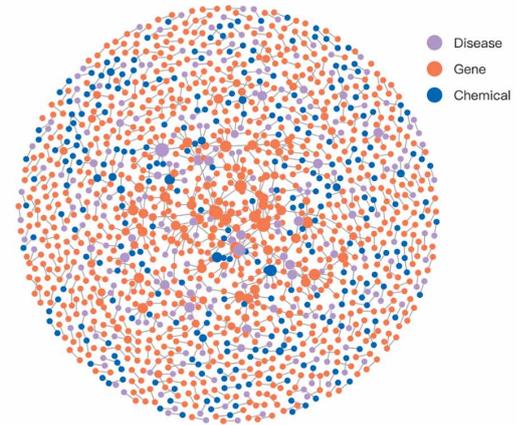
The scientific team

Aladdin's scientific team is composed of globally recognised scientists in the field of age-related disease, including professors from Cambridge University, Imperial College London, Norwegian Centre on Healthy Ageing, and Oslo University. The
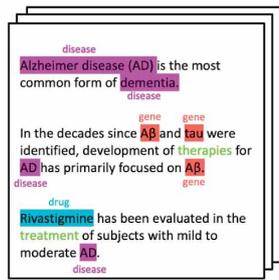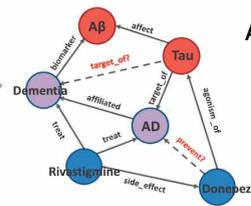
| 34 million biomedical literatures | Knowledge subgraph | Large-scale multi-omics knowledge graph |

◆ **Accelerating target identification, disease mechanism interpretation, drug repurposing and pipelines recommended**

publications created by the scientific advisory team have been cited more than 120,000 times.

Our chief scientific advisor, Professor David Rubeinsztein, is the Deputy Director of the Cambridge Institute of Medical Research (CIMR), the Academic Lead of the Alzheimer's Research UK (ARUK) Cambridge Drug Discovery Institute. He is also a Professor of Molecular Neurogenetics at the University of Cambridge and a UK Dementia Research Institute Professor.

Publications

Our scientific group has published more than 1,000 papers in leading scientific journals including, more than 100 papers in *Nature*, *Science*, and *Cell* in both main and sub-groups.

A unique business approach

The company focuses on two key areas:

AI drug discovery

Using our proprietary disease-centric Knowledge Graphs in conjunction with an award-winning AI drug discovery platform to speed up the traditional drug discovery process at the pre-clinical phase. In the future, we will be able to provide end-to-end solutions for the drug discovery process
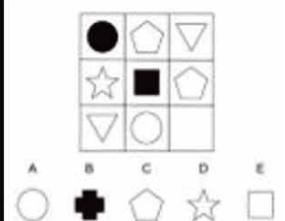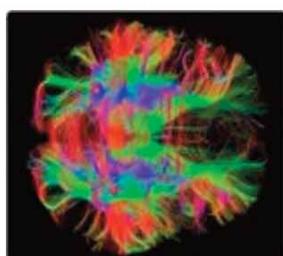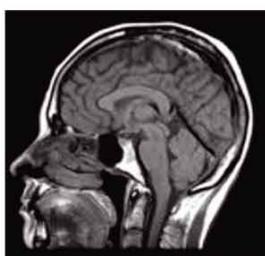
Early stage disease diagnosis

To create a gold standard for early stage diagnosis, we use our proprietary AI in conjunction with extensive multimodal data sets from multiple countries to make new discoveries.

We are ultimately targeting in the case of Alzheimer's disease, a non-invasive test that will be simple to implement, more accurate than current clinical standards, and ultimately affordable for the majority of the world's population.

AD Multimodal data and Biomedical Knowledge Graph/map

Aladdin is one of most innovative AI companies that uses extensive multimodal data approaches for drug discovery and biomarker discovery for dementias, including Alzheimer's disease. In addition to small molecule compounds libraries and publications from PubMed, Aladdin has access to extensive longitudinal datasets consisting of cognitive test results, general blood tests, EMRs, genetic risk profiling, MRI, PET, CSF, walking patterns, and other unique data. To complement new small molecule drug discoveries, the company is building biomedical knowledge graphs around aged-related disease to achieve target identification, pathological pathway discovery, mechanism analysis, and drug repurposing. The

Method	Accuracy (%)	Recall(%)	Precision(%)	Sensitivity(%)	Specificity(%)
SAE-PET (2015)	63.6	-	-	62.9	63.8
MOLR + DeepESRNet (2017)	70.3	-	75.5	72.6	79.1
Cascaded CNN (2018)	78.1	-	-	70.7	75.9
Y. Ding et al (2019)	-	-	76	81	84
Aladdin™	85.4	80.5	84.0	86.5	87.2

We have successfully increased the MCI diagnosis to 85.4%

Knowledge Graph can help to discover novel actionable insights, mechanisms, and potential drug treatments by uncovering key relationships between disease, genes, chemical compounds, and drugs.
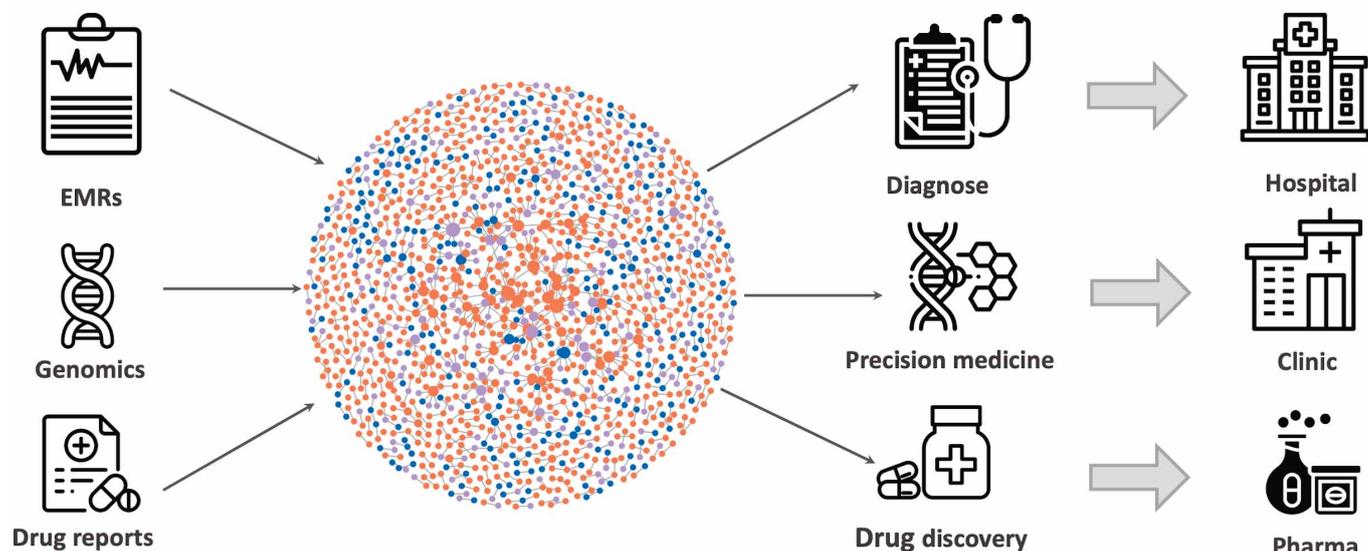
Alzheimer's disease

Aladdin´s AI team, through the use of advanced text mining techniques, was able to extract biomedical knowledge from over 30 million research articles on Alzheimer's disease and to construct a large scale of knowledge graph with more than 800,000 entities and over 10 million edges among diseases, targets, compounds, biomarkers, and genes. We will enter a consortium agreement with the Dementia Platform UK to further develop and license the AD Knowledge Graph in 2021, the consortium consists of 4 of the top 10 European Big Pharma.

COVID-19

We have taken a further step in fighting against the coronavirus pandemic by constructing a COVID-19 centric knowledge graph through the text mining of over 47,000 scholarly articles about COVID-19, SARS-CoV-2, and related coronaviruses. This includes further information on the transmission, incubation, and environmental stability of COVID-19, as well as data about risk factors, genetics, origin, and further development. At the same time, we hope to build a larger knowledge base of potential vaccines and therapeutics. Our knowledge graph for COVID-19 predicted the use of Dexamethasone as a potential aid for the disease in March 2020.

Extensive international data cohorts

One of the Holy Grails for using significant data in healthcare for discovery is having access to data

EMRs → **Genomics** → **Drug reports** → [Knowledge graph] → **Diagnose** → **Hospital**, **Precision medicine** → **Clinic**, **Drug discovery** → **Pharma**

◆Knowledge graph extension

other from European phenotypes, such as African, Indian etc. Aladdin is building up access to data from Europe, China, India, and the Middle East. It believes this diversity is paramount for creating an eventual global solution.

This gives Aladdin an advantage which will be catalysed by Aladdin building new disease risk assessment platforms that will enable all data to be gathered and stored in a digital machine-readable format. This is an exciting way forward, as traditional EMRs – whether from the US or UK – are generally non-complete and in different formats, which make it very difficult for machine learning.

Recent Achievements

Drug discovery platform

We provide valuable solutions to the pharmaceutical industry via our proprietary AI Drug Discovery platform that can accelerate the drug development process, including Virtual Screening, Hit to lead, and Lead Optimisation. We have rapidly identified multiple small molecule drug compounds with a high potential for novel approaches for multiple age-related disease, including Alzheimer's disease, Parkinson's disease, and COVID-19. For example, the AI virtual screen functionality of the Aladdin drug discovery platform achieved a recommendation success rate 40 times higher than traditional screening methods through recent co-operation with Oslo University.

Based on the drug discovery platform, Aladdin has also successfully identified Dexamethasone, a low-dose steroid treatment, as the leading potential repurposed drug candidate. Aladdin has presented its medical paper on COVID-19 centred knowledge graph at the ACM SIGKDD annual conference, the world premier forum for data mining.

COVID-19 (EU Innovative Medicines Initiative project)

Aladdin has become a member of a high-level consortium sponsored by EU IMI under the name 'Project Dragon'. The project aims to develop a precision medicine approach culminating in a scalable diagnostic tool for COVID-19, initially utilising extensive patient data from around the globe.

Over and above the Dragon Project, we have independently validated our high-level capability in the COVID-19 AI Diagnostic space. We have developed a fully automated deep learning process to detect and distinguish COVID-19 from other pulmonary diseases from CT images. Our research study has been published on IEEE.

Health Risk Assessment Platform

Aladdin has recently launched its Health Risk Assessment Tool to Airbus (India) and Saregama (India).

Aladdin's Publications

- Weakly Supervised Deep Learning for COVID-19 Infection Detection and Classification From CT Images;

- The NAD+-mitophagy axis in healthy longevity and in artificial intelligence based clinical applications;

- Biomedical Knowledge Graph of COVID-19: Construction and Applications

- Communicative Representation Learning on Attributed Molecular Graphs

- To improve the predictions of binding residues with DNA, RNA, carbohydrate, and peptide via multiple-task deep neural networks

Core team members' publications

In addition to those mentioned above, we also have a Chinese team, one of the core members of which is Shuangjia Zheng. Zheng is leading a team of award winning AI team members, and his publication can be found here.

In 2020 we began working closely with the following scientists, who act as our advisors and with whom we have several ongoing publications:

- David Rubeinsztien

- Evandro Fang Fei

- Jack Chen

- Guang Yang

- Yuedong Yang

- Yipeng Hu

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