Competition Name	Competition ID	Competition Code	Project Number	Participant Organisation Name	Participant Organisation Name	Has the intended project result been successfully achieved? Reason for Response	The main challenges addressed by the project, and a summary of the key achievements/ outcomes?	If the outcome was not in line with expectations, how has it helped to inform the change in the direction of your future R&D?	How will you take the project forward? What barriers to exploitation remain? Will partners be needed?	Are there any wider benefits which you have gained as a result of the grant-funded project?
312 - Digital Health Technology Catalyst Round 4	312	1902_HEAL_DHTC_R4	105834	L MBIC LIMITED	LIMBIC LIMITED	As a project team we have met the intended outcomes of the project within the stipulated time frame of the study. These outcomes were to: 1. Develop a patient facing mobile application to support individuals in therapy 2. Build an accompanying clinician dashboard synced to the patient app, thus completing the therapy assistant platform 3. Conduct a produce improvement study on the Limbic platform in its intended clinical environment 4. Perform a literature review to research the association of emotional state and heart rate variability 5. Run a study using the Limbic platform and a wearable fitness tracker to investigate whether physiological data can be used to predict mental state	Incoming referrals into the NHS Improving Access to Psychological Therapy (IAPT) mental health service are on the rise year-upon-year. Currently, patient engagement in IAPT is extremely low, at 50%. This is as a result of a culmination of factors: (1) poor quantification of mental state at triage, (2) efficient methods of measuring patient progress in treatment, (3) infrequent and limited contact time and interaction with patients. This has led to inconsistencies in treatment, resulting in the suboptimal delivery of care. This DHTC project has achieved the following: 1. Development of an AI-driven cha bot app to engage patients in their therapy, supporting them between treatment sessions and encouraging better par icipation in heir care 2. Creation of a clinician platform, synced to the mobile app, that delivers insight to support therapists in delivering personalised care to patients and making data-driven decisions about their care 3. Deployment of the Limbic platform (the two above points) in its intended clinical environment: supporting the delivery of cogni ive behavioural therapy. Through this study we demonstrated that Limbic positively engages patients, provides clinicians with greater insight and boosts the therapeutic alliance between patient and therapist. 4. Delivery of a study investigating whether physiological data, especially heart rate, could predict emotional state as defined by IAPT clinical measures. Through this study we found supporting evidence to suggest that heart rate can predict mental state - a first step in the road to developing a quantifiable method for mental health screening and triage. Comparing what we have achieved against what we set out to achieve, we believe we have delivered effectively on the scope of this project. Namely, the full development of the Limbic platform, its deployment and positive reception by patients and clinicians is testament to the good execution of this project. As a team, we are also really proud of the progress made to investigate the creation of a Bayesian framework for predicting emotional state from heartbeat data. We achieved a significant accuracy of 72% vs. a stated goal of 90%. We discuss implications for this below, but believe this is an important early finding in his nascent field.	One of the key differences between the study we conducted and many other similar studies is that the study participants were free to upload data as and when they wanted. Indeed, we saw a wide variety of levels of engagement with the data upload service in the study. This led to a very challenging data cleaning process from which we achieved 72% accuracy. From this highly naturalistic setting, we have learnt that the physiological data obtained during certain periods throughout he day are more predictive of emotional state, namely during the night hours. This has informed our research in two key ways. Firstly, we would like to better understand how our user base segregates into their level of continued engagement with our technology (for both our mobile platform and any future endeavours into fitness trackers). From this, we can learn how segments of our platforms community behave and how they present their emotional state. Secondly, we will investigate how data collected during the day and night contrast with respect to the clinical outcomes collected (again, both for our platform and any future endeavours into fitness trackers).	For the platform we have developed, we will look to establish pilots with IAPT providers to further investigate the utility of the platform and begin collecting health economics data. Our aim is to turn these pilots into commercial contracts linked to the delivery of KPIs, including impact on outcomes, resource savings and speed to recovery. The main barriers to this exploitation path will be: (a) establishing awareness and credibility amongst IAPT services and (b) strike a willingness to adopt technological change. Partners will be a necessity in order to overcome these barriers. Limbic will utilise existing collaborations with UCLPartners AHSN, our board and healthcare provider "friendlies" (such as West London CCG and SLaM) to help open the door to initial pilot conversations with IAPT services. We will look to leverage these partners to exploit low hanging fruit opportunities. We are building a community of therapists using the platform, who will be able to provide testimony (alongside engagement and efficacy data) that will support our case for adopting the platform. Additionally, we will look to continue our collaboration with Dr Julian, an IAPT service provider, as an immediate opportunity to continue generating data to support our case, whilst also exploring a potential commercial contract. With regards to the algorithm developed to predict emotional state, we have learned in this project that there is a wealth of information being collected by the mobile device itself. Further development of the emotional state algorithm will be complemented by inclusion of [redacted] This will allow Limbic to predict clinical measures of mood disorders at scale.	Through this project we have established a relationship with medical device and health economic experts at the University of Manchester. These connects will be valuable when conducting follow up studies/pilots of the Limbic platform and for consulting on future product development. Limbic team members have also gained experience in and exposure to e hics controlled studies, through he collaboration with KCL. The insight into how to set up, submit proposals for ethics approval and execute these studies will be important for any future R&D or commercial pilot research that may require a similar approval process. Finally, the impact of the COVID-19 pandemic has demonstrated internally that we are capable of delivering large scale projects in a completely remote environment. This has given us a lot of confidence that a) we can deliver on any pilots/commercial contracts with IAPT services as the impacts of COVID continue to affect health systems and b) we will be able to work seamlessly with other markets, for example the US, in a completely remote environment.
312 - Digital Health Technology Catalyst Round 4	312	1902_HEAL_DHTC_R4	105834	KING'S COLLEGE LONDON	KING'S COLLEGE LONDON	NA	The main challenge addressed by this project was to understand whether it is feasible to use technology (wristwatch fitness trackers and mobile apps) to monitor mood changes in patients with depression. The second main aim was to understand whether we could predict mood changes in patients with depression using algorithms developed from he data collected from wristwatch fitness trackers and mobile apps. One of the key achievements of this project includes he recruitment and data collection from 30 research participants. We collected data from recruited participants for a period of three months. From this, we were able to meet our work package objectives and achieve the main challenges set out at the start of he project. From this project we have understood that it is feasible to use remote technology in patients with depression. In addition, we have demonstrated that we are able to predict mood changes in patients with depression with an accuracy score of between 55-72%. We extensively reviewed literature on measurements of autonomic nervous system activity, particularly heart rate variability, and produced our own literature review looking at heart rate variability and how it is associated with affective states. This will be published in a peer-reviewed scientific journal.	The current project informed us that a future research study which aims to use data collected via wristwatch fitness trackers to predict mood changes in pa ients with depression is feasible but a future study will require a larger sample size and a longer follow-up time.	The main barriers to exploitation are a requirement to further develop the algorithm and funding resources. To take he project forward, we will work with experts in the field to develop a larger grant application to obtain further funding."	From this project we have further developed expertise and knowledge of the use of remote technology for patients with mental health problems. We have increased our opportunity to further develop this focus with o her organisations and academic institutions.
312 - Digital Health Technology Catalyst Round 4	312	1902_HEAL_DHTC_R4	105834	DR JULIAN MEDICAL GROUP LTD	DR JULIAN MEDICAL GROUP LTD	NA	Utilising Limbic tools to help patients improve their therapy experience	Na	Na	Na