Innovation Challenge Fund (ICF)

Concept Note Template

<table>
<tr><td>1.</td><td>Name / Organisation</td><td>Public Affairs Centre</td></tr>
<tr><td>2.</td><td>Email address / Phone number</td><td>pacindia.org/+91-80-27839918</td></tr>
<tr><td>3.</td><td>Title of Project</td><td>COVID 19: A Clinical Decision-Support System based on Machine Learning (CDSS-ML), to enable optimisation of resources and treatment responses</td></tr>
<tr><td>4.</td><td>Application for ICF Cluster</td><td>AI/Data Science, Karnataka</td></tr>
<tr><td>5.</td><td>Co-Members of the Consortium *
(Type – Indian Academia, Indian Business, International Academia, International Business, Indian non-commercial organisation, International non-commercial organisation, Other - specify)

* Information not mandatory for the concept note stage.</td><td>
<table>
<tr><th>#</th><th>Organization</th><th>Type</th></tr>
<tr><td>1.</td><td>International Institute of Information Technology – Bangalore (IIIT-B)</td><td>Indian Academia</td></tr>
<tr><td>2.</td><td>SuVitas</td><td>Indian Business</td></tr>
<tr><td>3.</td><td>Indian Institute of Health Management Research</td><td>Indian non-commercial organisation</td></tr>
<tr><td>4.</td><td>TBD</td><td>International Academia</td></tr>
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</td></tr>
<tr><td>6.</td><td>If you do not already have agreed consortium members, please indicate here the kind of partners you would like to hear from.</td><td>International Academia</td></tr>
<tr><td>7.</td><td>Are you content for us to publish your concept note on our web platform in order to encourage potential consortium members to reach out to you?</td><td>Yes</td></tr>
<tr><td>8.</td><td>Funding Requested (up to £250k)</td><td>£ 180,000</td></tr>
<tr><td>9.</td><td>Co-funding provided (if any) and source</td><td>Yes. £ 20,000 from PAC</td></tr>
<tr><td>10.</td><td>Please summarise your Innovation Challenge Fund research project in one sentence. (350-character limit)</td><td>Implement a scalable and replicable Clinical Decision-Support System based on Machine Learning (CDSS-ML), to help optimise scarce medical resources and personnel to respond to COVID-19 by prioritising patients with elevated co-morbidity risks from non-communicable diseases to enable risk-assessed patient triage and reverse triage; with features for addressing future pandemics.</td></tr>
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11.	Please describe your project further. What problem does your pilot seek to address? Who are the potential beneficiaries and other stakeholders? What are the inputs and activities, and what are the outputs? What does success look like after 12 months of funded research? How will your solution reach the market place? (*2500-character limit)* --- The public health system in India is the only institutional access and care for disadvantaged populations. COVID-19 has overwhelmed healthcare delivery by its scale and spread, and the significant comorbidity risks that arise from Non-Communicable Diseases (NCD). Other health care services, especially RCH services, have been crowded out. It is estimated, that COVID-19 has led to an over 25 percent decline in essential health services with institutional deliveries and immunisation decreasing significantly. This burden is borne by women, children and the poor. They will benefit most from this project. The proposed CDSS-ML will enable standardised and rule-based identification of COVID 19 related comorbidity risks across geographies, gender, age groups and over time in a unified framework. Data from primary health care centres on the cases of COVID-19 reported, related to pre-existing comorbidity from Cardio-Vascular Disease, Diabetes Mellitus, and Chronic Lung Disease and on recovery and mortality of patients, will be used as the training data for CDSS-ML. The key metric for this purpose will be the elevated risk threshold as the differentiator between COVID-19 patients at elevated NCD-led risk of mortality, who need intervention to save their lives and those who are at moderate or mild risk and can be treated as outpatients. An AI-based image reader algorithm will aid front line health workers in diagnostic prioritisation and reduce undue need for RT-PCR tests, for primary & secondary contacts of COVID-19 positive cases. The CDSS-ML predictive analysis will be central to patient triage and reverse triage as well as for supply-side resource optimisation. The implementation will focus on the most backward district in Karnataka - Yadgir. Partnering the state Health Department, the CDSS-ML will be implemented in 49 Public Health Centres (PHC), 6 Community Health Centres (CHC) and 3 taluka hospitals, over the 12-month period. The benefits to the primary health care system in Yadgir from the CDSS-ML will include: • Optimal patient triage and clinical treatment options • Resource optimisation that is context-specific and resource-sensitive • Mitigation of the COVID-19 impact on other essential public health services. The immediate outcome, in the COVID-19 recovery phase, will be to make the public health system equitable and resilient. The longer-term outcome, we expect as a result, will be an improved gender-sensitive access to essential health services. The CDSS-ML holds potential for commercialisation at scale across the public and private health systems in resource poor settings. We expect to develop a product prototype that builds a knowledge repository linking valuable data along multiple themes namely spatial (geo-locations), temporal (time periods) and contexts (COVID-19) and serves as a powerful tool to optimise health resources and enhance outcomes.	
12.	What is 'technological' about your proposed solution and why might this be appropriate to the challenge areas? *(1000-character limit)*	It will be a supervised learning model using a standard feedforward neural network, in 3 stages: 1. Use age, gender and comorbidity information to predict COVID-19 severity - whether we can accurately predict the severity of COVID-19 progression in a patient. 2. Use above inputs plus NCD-only mortality risk as well as patient mortality information to predict elevated mortality risk of NCD + COVID-19 - whether we can accurately predict the additional mortality risk after developing COVID-19 with pre-existing NCD.

		3. Use above inputs plus intervention information to predict the conditional mortality risk if various interventions are performed. An AI-based image reading algorithm, will help detect COVID related radiographic changes in the lungs. The CDSS-ML will balance accuracy and intelligibility. Data will be divided into training, validation and testing subsets. The validation set will be used to ensure that the model is not overfitting. We will evaluate the model based on its performance over the test set. Potential extensions to the model include adding the uncertainty of the prediction as an output to help medical professionals make better decisions.
13.	Is your proposed solution a response to the impacts of COVID-19, or an effort to contain the pandemic? If so, please explain. *(1000- character limit)*	The proposal responds to the impact of COVID-19 on the public health care system in India, currently, the third worst COVID-19 affected country - over 3 million cases and about 60,000 deaths. India has a long COVID-19 battle ahead that will exert enormous stress on the resource-constrained infrastructure and the limited numbers of front-line health workers. There is need for a data-science driven, innovative intervention that helps optimise India's COVID-19 response, in the immediate future, especially in relation to comorbidity-related patient outcomes. India's enormous healthcare challenge is multifactorial. Understanding the epidemiological transition is therefore central to an effective institutional response. Two major factors predominate: the rising burden of NCD in all states and the unacceptably high risk of child and maternal malnutrition. Therefore, from a data science-use case perspective, it is important to develop an ML model that provides high predictive accuracy on risk-based assessment to respond to COVID-19 and generates intelligible insights to optimise programmatic interventions for better NCD and RCH outcomes.
14.	Does your proposed solution contribute to combatting climate change or promoting a greener planet? If so, please explain. *(1000-character limit)*	Not applicable
15.	How is your proposal relevant to the development challenges of India? *(1000-character limit)*	With over 20 percent of the world's population living in India, the drivers of mortality and morbidity vary across the states, as do the quality and adequacy of the public healthcare system. Therefore, the importance and the urgency for data and artificial intelligence-based generation of knowledge to better understand the burden of NCD causing the most premature deaths in each state,

		the risk factors responsible for this burden and the options to ensure inclusive and improved health outcomes. The rationale that underpins the CDSS-ML proposed, is two-fold: First, the public health care delivery system across the states in India typically operates in resource - human capital, infrastructure, supplies and equipment - constrained environments. Resource optimising solutions that are evidence-based, fair and equitable are necessary conditions to improve health outcomes. Second, a vast majority of the community comprising the socially and economically disadvantaged, rely entirely on the public health system. This is especially true for the primary health care system that provides essential health services and is important for women.
16.	What consideration have you made of gender in developing your concept? Could your project address gender inequality or other kinds of inequality? *(1000-character limit)*	Two points need mention: First, women are in the forefront of the COVID-19 response: as front-line health care professionals and primary care givers. They are at a greater risk of being infected. The fact that there are widespread nutritional deficiencies among women raises the risk of morbidity and mortality. Gender will be an important data variable at all three stages of the supervised learning model. The model will generate gender-specific predictive analysis. This will enable better understanding of the gender-risk patterns, thus, enabling woman-centric health interventions. Second, in the wake of the COVID-19 pandemic, there is evidence of a decline in the provision of and access to essential health services, especially reproductive and child health services by the primary health care system. The brunt of this failure will be borne by the socially and economically underprivileged. We expect that the CDSS-ML model will help mitigate the impact of COVID-19 on essential health services. The optimised patient triage and treatment options based on the threshold risk rule, will likely reduce the crowding-out impact of COVID-19 on services that the poor need.
	Notes: *Please be kindly reminded of the primary criteria: relevance to the environmental and/or C19 agenda. See boxes 13 and 14.* *Except box 5, all boxes require mandatory response.* *In the interests of fairness, proposals that exceed the character limits will not be considered.*	