

# FINAL TECHNICAL REPORT\_UNIVERSITÉ DU RWANDA

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*IDRC GRANT / SUBVENTION DU CRDI : - LEVERAGING AI AND DATA SCIENCE TECHNIQUES IN  
HARMONIZING, SHARING, ACCESSING AND ANALYZING SARS-COV-2/COVID-19 DATA IN RWANDA*

# Global South AI4COVID Program

## Final technical report template

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### Section 1: Project information

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Project title	Leveraging Artificial Intelligence and Data Science Techniques in Harmonizing, Accessing and Analysing SARS-COV-2/COVID-19 Data in Rwanda (LAISDAR Project)
IDRC project number	Grant No. 109587-001
Report type (first progress report, interim progress report, final technical report, etc.)	Final technical report
Period covered by the report	1 <sup>st</sup> October 2020– 30 <sup>th</sup> June 2023
Report author(s)	Prof. Charles Ruranga (Lead PI) ( <a href="mailto:cruranga@gmail.com">cruranga@gmail.com</a> ) Akili Viviane (Project Coordinator)
Name of lead research institution	University of Rwanda
Start date of project	1 <sup>st</sup> October 2020
Project budget (in \$ CAD)	1,282,900 \$ CAD

## Section 2: Narrative report

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### 2.1 Objectives

The general objective of the LAISDAR project was Leveraging Artificial Intelligence and Data Science Techniques in Harmonizing, Accessing and Analysing SARS-COV-2/COVID-19 Data in Rwanda.

The specific objectives of the LAISDAR project were:

1. To inventory all existing collected data on COVID-19 in Rwanda, assess its quality, periodicity, and readiness towards the common data model.
2. To create the framework for data harmonization to the OMOP Common data model (OMOP CDM): We will start by mapping full hospital patients records, focusing on 8 hospitals located in regions with high number of COVID-19 patients and completing with other isolated datasets.
3. To collect OMOP CDM based prospective enriched data on COVID-19 from the community through mobile surveys applications, face- to-face validation survey, and potentially other sources if available like geofencing data.
4. To build a common data query interface with analytical tools including OHDSI open source tools and ML.
5. To leverage both traditional mathematical modelling techniques, statistical methods and machine learning methods for prediction models for the burden of COVID-19 in the community but also the potential impact on hospital admissions or overall infection rates and the impact of various public health measures on 1) the pandemic evolution in the country; 2) on social-economic situation, and on 3) mental health (stratified by gender and other vulnerable groups).

The LAISDAR project has successfully met all of its objectives without any changes or evolution. In order to ensure a smooth completion of the project and facilitate the publication and dissemination of its findings the project has obtained two no-cost extensions. The first extension covers the period from October 1st, 2022 to March 31st, 2023, while the second extension begins on April 1st, 2023, and ends on June 30th, 2023.

### 2.2 Approach and workplan

The research approach, methodology and key activities have been implemented as planned. Collected data has been analysed and findings disseminated through conferences, workshops and publications.

### 2.3 Research findings

Many studies have been conducted in this project. Key research findings are presented in this section.

1. ***Leveraging artificial intelligence and data science techniques in harmonizing, sharing, accessing and analyzing SARS- COV2/COVID-19 data in Rwanda (LAISDAR Project): study design and rationale.*** A paper published in BMC Medical Informatics and Decision Making. <https://doi.org/10.1186/s12911-022-01965-9>.

- **Background:** Since the outbreak of COVID-19 pandemic in Rwanda, a vast amount of SARS-COV-2/COVID-19-related data have been collected including COVID-19 testing and hospital routine care data. Unfortunately, those data are fragmented in silos with different data structures or formats and cannot be used to improve understanding of the disease, monitor its progress, and generate evidence to guide prevention measures. The objective of this project is to leverage the artificial intelligence (AI) and data science techniques in harmonizing datasets to support Rwandan government needs in monitoring and predicting the COVID-19 burden, including the hospital admissions and overall infection rates.
- **Methods:** The project will gather the existing data including hospital electronic health records (EHRs), the COVID-19 testing data and will link with longitudinal data from community surveys. The open-source tools from Observational Health Data Sciences and Informatics (OHDSI) will be used to harmonize hospital EHRs through the Observational Medical Outcomes Partnership (OMOP) Common Data Model (CDM). The project will also leverage other OHDSI tools for data analytics and network integration, as well as R Studio and Python. The network will include up to 15 health facilities in Rwanda, whose EHR data will be harmonized to OMOP CDM.
- **Expected results:** This study will yield a technical infrastructure where the 15 participating hospitals and health centres will have EHR data in OMOP CDM format on a local Mac Mini ("data node"), together with a set of OHDSI open-source tools. A central server, or portal, will contain a data catalogue of participating sites, as well as the OHDSI tools that are used to define and manage distributed studies. The central server will also integrate the information from the national Covid-19 registry, as well as the results of the community surveys. The ultimate project outcome is the dynamic prediction modelling for COVID-19 pandemic in Rwanda.
- **Discussion:** The project is the first on the African continent leveraging AI and implementation of an OMOP CDM based federated data network for data harmonization. Such infrastructure is scalable for other pandemics monitoring, outcomes predictions, and tailored response planning.

2. ***Domestic Violence and associated factors during COVID-19 in Rwanda: A country-wide longitudinal study.*** A manuscript submitted for publication to the Journal of Child and Family Studies.

- **Message of the paper:** The paper assessed the behaviors associated with domestic violence among partners and parents towards their children during the period of Covid-19. The study used primary data from a country-wide longitudinal community survey conducted in Rwanda between December 2021 and March 2022. A total of 26,412 responses were

received from around 4400 participants surveyed in 6 recurrent bi-weekly phases. We reached respondents via phone calls and consented on phone to participate in the survey.

- **Why was the model used was important:** We used Chi-square test to compare the observed results with the expected results, Logistic regression to estimate the relationship between the family violence and all the independent variables. Finally, the model helped to estimate the proportion and look for the significance of the confidence interval. The findings indicate different forms of domestic violence as a result of COVID 19. Men were the main perpetrators of violence against their partners (69%) while women were the main perpetrators of violence against children (68.6%). Moreover, men were thrice as likely as women to commit violence. Other variables associated with domestic violence include change in income, employment status, inability to afford basic necessities and the socioeconomic status (Ubudehe category 1).
- **Implications for vulnerable communities or the public more generally:** Children, poor women and vulnerable families, such as those in the low socioeconomic category (Ubudehe category 1), are the worst victims of domestic violence during covid 19
- **Opportunities for the use of evidences:** Policy makers in charge of family welfare and stakeholders should aim to eradicate all form of inequalities to prevent domestic violence in the period of crisis.

### 3. *Assessing factors associated with adherence or compliance to preventive measures of covid 19 in Rwanda: A community survey.* A manuscript submitted for publication in BMJ Open.

- **Objective:** To assess the level of compliance with COVID-19 preventive measures and compliance associated factors in the Rwanda community.
- **Design:** Cross-sectional study
- **Settings:** Country wide community survey in Rwanda
- **Participants:** 4763 participants randomly sampled following the sampling frame used for the recent Rwanda Demographic Health. Age between 22 to 94 years old.
- **Outcomes:** Complying to wearing a face mask, hand washing and social distancing and pre-existing factors associated with compliance.
- **Methods:** Between 14<sup>th</sup> to 27<sup>th</sup> February 2022, a longitudinal survey using telephone calls was conducted and included questions on participants demographics data and how the Covid-19 preventives measures were followed. A verbal consent was obtained from each participant. The compliance on three main preventive measures: wearing a mask, washing hands and social distancing were the main outcomes. The univariate and multivariable logistic regression analyses were performed to evaluate the associated factors (age, gender, level of education, socio-economic status) with compliance.
- **Results:** The compliance with the three primary preventive measures (washing hands 98.4%, wearing a mask 97.1%, and observing social distance 97.9%) was at a rate of 95.5%. The mean age was 46± 11 SD (range 22-98), 69% were female and 86.5% reached the primary and below education level. There was a significant association among the three primary preventive measures (p-value < 0.05) according to bivariate and regression analysis. Avoiding handshake greetings and not attending any social gatherings were both

associated with the aforementioned three preventive measures according to a univariate analysis as well as for hand washing and gender. Handshakes and greetings showed unreliable association with wearing masking and social distancing in multivariable regression

- **Conclusion:** Compliance with the three key preventive measures against Covid-19 was high in the Rwandan community and these measures were interdependent. The importance of all three measures should be emphasized for effective disease control.

4. ***Assessment of the socioeconomic impact of COVID-19 in Rwanda: Findings from a country-wide community survey.*** A manuscript finalized and ready for submission for publication.

- **Rationale:** The COVID-19 pandemic disrupted socioeconomic situations worldwide, and there is a scarcity of documentation regarding the impact of COVID-19 on the day-to-day lives of households, particularly in low- and middle-income countries.
- **Objective:** This study describes the interplay between multiple factors to assess the socio-economic impact of COVID-19 on the Rwandan population at micro-level (household).
- **Methods:** Data from a community survey conducted in Rwanda between December 2021 and March 2022 were used. A total of 26412 response forms were received from around 4400 participants surveyed in 6 recurrent bi-weekly phases where participants were randomly selected. A Multivariable Logistic regression model was employed to assess the socioeconomic impact of COVID-19 on households' income using a backward stepwise elimination algorithm.
- **Results:** The findings demonstrate that individuals living without a partner face a greater likelihood of experiencing a decline in income during the COVID-19 pandemic compared to those living with a partner. Moreover, as the number of children in a household increases, the risk of income reduction also escalates. When examining education levels, individuals who did not attend school are 27 times more likely to experience a decrease in income, while those with primary school attendance are 5 times more likely, and individuals with secondary school attendance are almost 2 times more likely to encounter a decrease in income. These results highlight the significant impact of partnership status, the number of children in a household, and educational attainment on the vulnerability to income reduction in the context of COVID-19.
- **Conclusions:** The findings from this research will be used by policymakers and other stakeholders to design and implement preventive and responsive measures for the future pandemics.

5. ***Modelling and Forecasting of COVID-19 New Cases in Rwanda Using Reproduction number ( $R_t$ ) based Bayesian approach.*** A manuscript finalized and ready for submission for publication.

- **Background:** The COVID-19 pandemic caused by the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) has affected the world extensively. Rwanda reported its first case on March 14, 2020, and as of December 05, 2022, over 132,317 individuals have tested

positive with a positivity rate of over 2%. The fatality rate has remained below 1%. Rwanda has achieved a high vaccine coverage rate of 98%, with 61% of fully vaccinated individuals receiving booster doses. To control the spread of COVID-19, Rwanda implemented non-pharmaceutical interventions. However, evaluating the effectiveness of these interventions requires predictive models that take into account vaccine coverage and SARS-CoV-2 variant dynamics. In this study, we developed statistical models that can predict new cases and real-time reproductive numbers to serve as an early warning tracking system for new infections. The prediction models incorporate vaccine coverage and SARS-CoV-2 variant dynamics to improve accuracy

- **Methods:** To estimate the spread of COVID-19 in Rwanda, we utilized real-time Bayesian estimation of epidemic approaches that directly relate to time series data of COVID-19 cases. These approaches are based on standard SIR-class models and account for cases from reservoir sources. We constructed a model in a discrete probabilistic form and quantified uncertainty in the estimation of epidemiological parameters and future cases. We also incorporated new data into the model to reduce uncertainty. We fitted models using both new cases and real-time reproduction number ( $R_t$ ) to identify the factor influencing the spread of COVID-19 and reproduction number. We conducted a sensitivity analysis to evaluate the models.
- **Results:** Using data from Rwanda, we estimated the real-time reproductive number ( $R_t$ ) of COVID-19. The approach we developed for estimation can also be applied to other outbreaks that may occur in the future. The Poisson model and Linear Regression model provide insights into the impact of different covariates on predicting the count of cases and the  $R_t$  value, respectively. Both "Lockdown" and the two doses of the "Vaccine" have a significant effect in both models, while "Week" appears to be less impactful in predicting the outcomes.
- **Conclusion:** The real-time reproduction number ( $R_t$ ) and prediction models developed in this study for COVID-19 in Rwanda are essential tools for outbreak response. These tools allow the government to implement evidence-based prevention measures and inform strategies to limit the spread of the disease. The findings of this study should aid in the preparation of plans for the further spread of the COVID-19 epidemic in Rwanda, and assist in the management of future outbreaks.

## 2.4 Gender and diversity

The project has integrated gender dimension in all steps of all the activities. There are two gender experts among the investigators and more than 50% of data collection enumerators were female and around 70% respondents in the longitudinal survey were female. Gender experts were leading the team in writing a paper on domestic violence during COVID-19. The manuscript has been presented in the conference and submitted for publication in a peer reviewed journal. The summary of the paper is given in the following paragraph.

The Covid 19 pandemic has exacerbated and increased anxiety and stress levels that can further



increase the rates of different forms of domestic violence in Rwanda like in other part of the world. This paper aims to assess the behaviors associated with domestic violence among partners and parents towards their children during the period of Covid-19. The study used primary data from a country-wide longitudinal community survey conducted in Rwanda between December 2021 and March 2022. A total of 26,412 response forms were received from around 4400 participants surveyed in 6 recurrent bi-weekly phases. We reached respondents via phone calls and consented on phone to participate in the survey. In the analysis we used Chi-square test to compare the observed results with the expected results, Logistic regression to estimate the relationship between the family violence and all the independent variables. Finally, we estimated the proportion and looked for the significance of the confidence interval. The findings indicate different forms of domestic violence as a result of COVID 19. Males tended to be primary perpetrators of violence against partners (69%) while females predominate for violence against children (68.6%). Moreover, men were thrice as likely as women to commit violence. Other variables associated with domestic violence include change in income, employment status, inability to afford basic necessities and the socioeconomic status (Ubudehe category 1). These findings are important for policy options to support families and the population in general to mitigate family violence incidences during pandemics like COVID 19.

## 2.5 COVID-19 context

- During the implementation of this project, Rwanda experienced a series of lockdowns due to the COVID-19 pandemic. These lockdowns significantly disrupted research activities, preventing researchers from meeting, traveling, and collecting data in the field. No cost extension of nine months was granted to be able to implement all activities of the project.
- Despite the difficulties, one positive impact of the COVID-19 pandemic was observed. The participants involved in data collection demonstrated readiness and motivation to provide information that would contribute to the fight against COVID-19. Their active involvement and willingness were beneficial to the project's overall goals.

## 2.6 Key achievements and outcomes

Key achievements of this project are:

- 1. Mapping and harmonization of hospitals data.** Mapping and harmonization of hospitals data were very important for policy makers and researchers. This activity has been done in health centres and hospitals selected in this project. The following activities have been done:
  - 1.1 Identification of all existing inventories of collected data on COVID-19 in Rwanda: Existing data were identified and put together in a single data hub server.
  - 1.2 Distribution and Connection of Macmini machines in 13 Hospitals: Macmini machines were connected in 13 HFs for data harmonization.
  - 1.3 Training of ITs from 15HFs: ITs from 15 HFS were trained about the Observational



## Medical outcomes Partnership (OMOP) & Common Data Model (CDM).

### **2. Longitudinal data collection and dataset**

The primary data on Covid-19 was collected in a longitudinal way. Multiple observations were taken from a group of selected people over different survey rounds. Each round happened once in two weeks between December 2021 and March 2022. SoGo survey software was used for data collection.

Initially, 4,400 participants were randomly selected from the Rwanda Demographic Health Survey, which was based on the fourth Rwanda Population and Housing Census provided by the National Institute of Statistics of Rwanda (NISR) in 2020. This sampling frame covered all 30 administrative districts in the country. The survey was conducted in six recurring bi-weekly phases, and a total of 26,412 responses were collected. The respondents were contacted via their phone numbers and provided phone-based consent to participate in the survey.

From this survey there is a rich longitudinal dataset that offers a lot of opportunities to policy makers/researchers in modelling the dynamics of the diseases and people's behaviours during the pandemic.

### **3. Longitudinal data analysis**

Using longitudinal dataset the following studies have been conducted:

- 3.1 Assessing factors associated with adherence or compliance to preventive measures of covid 19 in Rwanda: A community survey.
- 3.2 Domestic Violence and associated factors during COVID-19 in Rwanda: A country-wide longitudinal study.
- 3.3 Socioeconomic impact of COVID-19 in Rwanda: Findings from a country-wide community survey.
- 3.4 Modelling and Forecasting of COVID-19 New Cases in Rwanda Using Reproduction number ( $R_t$ ) based Bayesian approach.
- 3.5 Predictors of depression, anxiety and mental well-being during the COVID-19 pandemic in Rwanda. A linear mixed effect model approach.

### **4. Creation of a dashboard for longitudinal dataset collected in this project.**

The dashboard was created with multiple visualization features to understand the dynamics of Covid-19 in the context of Rwanda. In this dashboard, appropriate information can be accessed by users including but not limited to Demographics of the participants, Chronic Diseases, COVID preventive measures, Enforcing of measures of Covid19, Covid Test information from the survey participants, Mental health, Socio-economic status, Stigma or beliefs that a group of people have about Covid19, as well as information about Symptoms of Covid among the participants during the survey period.

## 2.7 Lessons learned

1. The LAISDAR project was among the unique collaborative research projects that brings together four colleges researcher at university of Rwanda, namely the college of medicine and health sciences (CMHS), the College of Science and Technology (CST), the College of Arts and Social Sciences (CASS) and College of Business and Economics (CBE). The project also involves researchers from 3 centres of excellences namely African Centre of Excellence in Data Sciences (ACE-DS) implemented by UR/CBE, the Regional Centre of Excellence in Biomedical Engineering and eHealth (CEBE) implemented by UR/CMHS and the Centre for Gender Studies (CGS) is one of the Academic Centres within the College of Arts and Social Sciences (UR/CASS). Beyond the UR researchers the consortium also collaborated with extramural investigators, including Rwanda Biomedical Centre (RBC) an implementation body of the Rwandan Ministry of Health, the Regional Alliance for Sustainable Development (RASD), a non-governmental organisation in Rwanda, Edence Health NV, a private data science company based in Belgium and the Belgian researchers from Ghent university.
2. The process of collecting data remotely taught the team some important lessons. They learned that persistence, excellent communication skills, and empathy were necessary to build trust with the respondents. The team faced challenges such as network connectivity issues and participants being busy at the time of the call, which sometimes required rescheduling.
3. Short period of execution (administration processes took longer, i.e. in the time of COVID-19), Future project should have a longer period of implementation and for sustainability purposes
4. More weight to be given to capacity building for stakeholders and end-users/ increase training sessions
5. Also collecting sensitive data over phone calls raises privacy and security concerns among respondents. Eg: When individuals are asked to provide personal or sensitive information over the phone, some may be worried about the confidentiality and protection of their data.

## Section 3: Project management considerations

### 3.1 Management of sub-grants

The LAISDAR Project had 4 sub grantees including Rwanda Biomedical Center (RBC), Regional Alliance for Sustainable Development (RASD) Rwanda, Edence Health NV (Edence), and University Teaching Hospital (CHUK). Each has specific tasks and the related budget for implementation based on the sub agreements signed with UR. There was a focal person in each sub grantees and all sub-grantee investigators participated regularly in a weekly research meeting of the LAISDAR project.

- **Rwanda Biomedical Center (RBC):**

RBC is leading the data collection on COVID-19 in Rwanda. On this project it facilitates the data gathering, providing guidance on new data collection and on data analysis, to meet the government and health partners' needs. RBC has played a vital role in project outcome/ generated knowledge uptake, use and impact.

- **Regional Alliance for Sustainable Development (RASD) Rwanda:**

RASD provides the project management on daily basis activities and lead the work package 6 (WP6) focusing on Dissemination, Exploitation and Communication.

- **Edence Health NV (Edence), Belgium:**

The Edence Health was in charge of establishing the technical infrastructure to support the network studies in scope and to harmonizing the data partners' data sources to the OMOP Common Data Model (OMOP CDM). Specifically, Edence Health has led WP2 and WP3, the technical and ICT- based core activity of the INTERCOHORT project. Moreover, it has also contributed to other WPs including WP1, WP4, WP5 and WP7 participating in successful fulfilment of the mission of the project.

- **University Teaching Hospital (CHUK):**

CHUK was responsible for readiness of hospital information management system used in CHUK for the LAISDAR Project.

### 3.2 Key challenges encountered

1. Delays in obtaining needed reports from subgrantees. A regular follow up has been done by the LAISDAR implementing team to get all needed reports and information.
2. Delays in obtaining authorization to collect data and have access to hospital datasets (Ethical clearances from RNC, NHRC, Authorization from MOH, NCST, IRB/CHUK & Non-disclosure agreement). Project started during COVID-19 where physical meetings were not possible so project received all authorizations with delays.
3. Recruitment and training of data collectors' processes: Recruitment and data training were done during COVID-19 where meetings and other gathering were restricted. These activities delayed.

### 3.3 Milestones

Milestone number	Milestone name	Related work package(s) (See the description in the timelines table)	Original due date in month (additional time needed in months)	Means of monitoring and verification
MS4	1st version of available COVID-19 datasets	WP1	6 +6+6	Report
MS5	1st hackathon on Database structure of listed COVID-19 datasets	WP1	6 +6+6	Report
MS6	Validated Survey questionnaires	WP1	6 +6+6	Report
MS7	2nd Consortium meeting	WP1, WP2, WP3, WP4, WP5, WP6, WP7	6 +6 +6	List of invited and confirmed members to the Meeting and Meeting's Minutes
MS8	1st round of data collection launched	WP3	7 +6 +6	List of participants

MS9	1st hackathon leveraging the White Rabbit and Rabbit-in-A-hat tools from OHDSI on initial datasets	WP2, WP3, WP4	8 +6 +6	List of participants
MS10	1st hackathon defining the data elements of importance	WP2, WP3, WP4	9 +6 +6	List of participants
MS11	1st hackathon defining OMOP (OHDSI) common data model-matching and eventual extension	WP2, WP3, WP4	9 +6 +6	List of participants
MS12	2 <sup>nd</sup> hackathon ETL and mapping process	WP2, WP3, WP4	9 +6 +6	List of participants
MS13	Full ETL and mapping process finished	WP1, WP2, WP3, WP4, WP5, WP6, WP7	12 +6 +6	Agreement
MS14	Single dataset test on basic statistics	WP2, WP3, WP4	12 +6 +6	Report
MS15	6 round of new data collection closed	WP4	12 +6+6	Report
MS16	3 <sup>rd</sup> Consortium meeting	WP1, WP2, WP3, WP4, WP5, WP6, WP7	12 +6+6	List of invited and confirmed members to the Meeting and Meeting's Minutes
MS17	4 <sup>th</sup> Consortium meeting	WP1, WP2, WP3, WP4, WP5, WP6, WP7	16 +6+6	List of invited and confirmed members to the Meeting and Meeting's Minutes

### 3.4 Adjustments to budget or timelines

The following budget adjustments were made:

1. The auditing costs have been added to the original project budget: \$28.560 or CAD 36.528
2. The budget related to setting up a Call Centre were transferred to one of our sub-grantees, the Rwanda Biomedical Centre (RBC) after an approval from IDRC.

## Section 4: Research outputs

### 4.1 Publications and papers

No	Title	Author (s)	Author (s)' gender	Venue (journal name, book, series, etc.)	Date submitted / accepted / published	Open access	Peer review ?	Uploaded to IDRC Connect ?	Link(if available online)
1	LAISDAR – A federated data network to support COVID19 research in Rwanda	Halvorsen, L., Descamps, F., Houghtaling, J., et al.	Both M, F	Observational Health Data Sciences and Informatics (OHDSI)		YES	Yes	Yes	<a href="https://www.ohdsi.org/2021-global-symposium-showcase-10/">https://www.ohdsi.org/2021-global-symposium-showcase-10/</a>
2	Leveraging artificial intelligence and data science techniques in harmonizing, Sharing. Accessing and analyzing SARS-COV2/COVID-19 data in Rwanda (LAISDAR Project): Study design & Rationale	Nishimwe, A., Ruranga, C. et. al.	Both M, F	BMC Medical Informatics and Decision Making 22, 214 (2022)	Submitted: 4th March 2022 Accepted: 9th August	Yes	Yes	Yes	<a href="https://bmcmedinformdecismak.biomedcentral.com/articles/10.1186/s12911-022-01965-9">https://bmcmedinformdecismak.biomedcentral.com/articles/10.1186/s12911-022-01965-9</a>
3	Assessment of the socioeconomic impact of COVID-19 in Rwanda: Findings from a country-wide community survey	Uwimana, A., Mukamana, L., Ruranga, C. et al.	Both M, F		Under review			No	
4	Domestic Violence and associated factors during COVID-19 in Rwanda: A country-wide longitudinal study	Mukamana, L., Rubagiza, J., Ruranga, C., et al.			Under review			No	

5	Lessons learned in SARS COV 2 Data gathering in Rwanda for further analysis	Nishimwe, A., Ruranga, C., Mugeni, R., et al.	Both M,F		Manuscript nearly complete			No	
6	Assessing factors associated with compliance to preventive measures of covid 19 in Rwanda: A community survey	Mugeni, R., Ruranga, C., Mutezimana, E. et al.	Both M& F		Under review			No	
7	Modelling and Forecasting of COVID-19 New Cases in Rwanda Using Reproduction number (Rt) based Bayesian approach	Semakula, M., Ruranga, C., Uwimana, A., et al.	Both M&F		Under review			No	
8	Predictors of depression, anxiety and mental well-being during the COVID-19 pandemic in Rwanda. A linear mixed effect model approach	Jansen, S., Nzabanita, J., Ruranga, C., et al.	Both M&F		Ongoing			No	

## 4.2 Policy and public engagement

No	Title	Author (s) and institution(s)	Author (s)' gender	Venue (journal name, book, series, etc.)	Date submitted /accepted/ published	Open access	Peer review?	Uploaded to IDRC Connect?	Link(if available online)
1	LAISDAR – A federated data network to support COVID19 research in Rwanda	Halvorsen, L., Descamps, F., Houghtaling, J., et al.	Both M, F	Observational Health Data Sciences and Informatics (OHDSI)		YES	Yes	Yes	<a href="https://www.ohdsi.org/2021-global-symposium-showcase-10/">https://www.ohdsi.org/2021-global-symposium-showcase-10/</a>
2	Leveraging AI and Data Science Techniques in Harmonizing, Sharing, Accessing and Analyzing SARS-COV-2 Data in Rwanda (LAISDAR Project)	Nishimwe, A., Ruranga, C. et. al.	Both M, F	1st Rwanda STI Conference 2022 organized by National Council for Science and Technology, Kigali, Rwanda	31st March and 1st April 2022.			Yes	<a href="https://bmcdinformeddecision.biomedcentral.com/articles/10.1186/s12911-022-01965-9">https://bmcdinformeddecision.biomedcentral.com/articles/10.1186/s12911-022-01965-9</a>
3	LAISDAR- General Research Meeting	LAISDAR Team	Both M, F	Serena Hotel, Kigali, Rwanda	May 20 <sup>th</sup> 2022			No	
4	The LAISDAR Project	LAISDAR Team	Both M, F	International Conference on Public Health in Africa (CPHIA 2022), Kigali, Rwanda	12-15 December, 2022				
5	International closing and dissemination conference organized by LAISDAR Project	LAISDAR Team	Both M, F	Kigali, Rwanda	15th and 16th June 2023			No	



### 4.3 Outreach tools and processes

Type (policy brief, blog, opeds, brochure, etc.)	Name/ title of publication	Date	Reach (global, regional, national, local)	Focus of tools	Link (if available online)
Website	LAISDAR website		Global		<a href="http://laisdar.rbc.gov.rw/">http://laisdar.rbc.gov.rw/</a>
Twitter	LAISDAR twitter account		Global		@laisdar (at twitter)
Blog	Towards Building A Harmonized COVID-19 Data System: A Look At Rwanda	Wednesday, 06 October 2021	Global		<a href="https://covidsouth.ai/research/blogs/Towards-Building-A-Harmonized-COVID-19-Data-System-A-Look-At-Rwanda">https://covidsouth.ai/research/blogs/Towards-Building-A-Harmonized-COVID-19-Data-System-A-Look-At-Rwanda</a>
Blog	Collecting COVID-19 Longitudinal Data Across Communities in Rwanda	Tuesday, 07 June 2022	Global		<a href="https://covidsouth.ai/research/blogs/Collecting-COVID-19-Longitudinal-Data-Across-Communities-in-Rwanda">https://covidsouth.ai/research/blogs/Collecting-COVID-19-Longitudinal-Data-Across-Communities-in-Rwanda</a>
Blog	Leveraging Artificial Intelligence and Data Science Techniques for COVID-19 Response: Highlights and Lessons Learned from the LAISDAR Project in Rwanda	Tuesday, 28 March 2023	Global		<a href="https://covidsouth.ai/research/blogs/Leveraging-Artificial-Intelligence-and-Data-Science-Techniques-for-COVID-19-ResponseHighlights-and-Lessons-Learned-from-the-LAISDAR-Project-in-Rwanda">https://covidsouth.ai/research/blogs/Leveraging-Artificial-Intelligence-and-Data-Science-Techniques-for-COVID-19-ResponseHighlights-and-Lessons-Learned-from-the-LAISDAR-Project-in-Rwanda</a>

#### 4.4 Media coverage and citations in public events

Type (radio, speech, interview, etc.)	Title	Name of publication, network, etc.	Date	Reach (global, regional, national, local)	Focus of article or broadcast	Link (if available online)
News papers	Rwanda to use Artificial Intelligence in Covid-19 forecast	Press conference for launching LAISDAR Project	February 26, 2021	Global	Public awareness	<a href="https://rwanda.shafaqna.com/EN/AL/214301">https://rwanda.shafaqna.com/EN/AL/214301</a> <a href="https://www.newtimes.co.rw/news/rwanda-use-artificial-intelligence-covid-19-forecast">https://www.newtimes.co.rw/news/rwanda-use-artificial-intelligence-covid-19-forecast</a>
TV/Radio	Women scientists playing a role in fighting COVID 19	International Day of Women in Science IDWS 2021	February 10, 2021	National	Public education, awareness and dissemination	
News papers	LAISDAR Project donates IT equipment worth 30M to 15 hospitals and Health Centre	Official handover of IT infrastructures to 15 Health facilities donated by LAISDAR project	30/9/2022	National	Public awareness	<a href="https://ur.ac.rw">https://ur.ac.rw</a> <a href="https://ur.ac.rw/?LAISDAR-project-donates-IT-equipment-worth-30M-to-15-Hospitals-and-Health#.Y1yuxvd0D50.whatsapp">https://ur.ac.rw/?LAISDAR-project-donates-IT-equipment-worth-30M-to-15-Hospitals-and-Health#.Y1yuxvd0D50.whatsapp</a> <a href="https://rbc.gov.rw">https://rbc.gov.rw</a> <a href="https://mobile.igihe.com">https://mobile.igihe.com</a> <a href="https://www.google.com/url?sa=t&amp;rct=j&amp;q=&amp;e_src=s&amp;source=web&amp;cd=&amp;cad=rja&amp;uact=8&amp;ved=2ahUKewj-vcOg3oz7AhVE_bslHV3ZBE8QFnoECBEQAQ&amp;url=https%3A%2F%2Fmobile.igihe.com%2Famakuru%2Fu-rwanda%2Farticle%2Famavuriro-15-yashyikirijwe-mudasobwa-z-arenga-miliyoni-30frw-zizifashishwa-mu&amp;usg=AOvVaw2HTPdxXXISiYW-BJ47jfvT">https://www.google.com/url?sa=t&amp;rct=j&amp;q=&amp;e_src=s&amp;source=web&amp;cd=&amp;cad=rja&amp;uact=8&amp;ved=2ahUKewj-vcOg3oz7AhVE_bslHV3ZBE8QFnoECBEQAQ&amp;url=https%3A%2F%2Fmobile.igihe.com%2Famakuru%2Fu-rwanda%2Farticle%2Famavuriro-15-yashyikirijwe-mudasobwa-z-arenga-miliyoni-30frw-zizifashishwa-mu&amp;usg=AOvVaw2HTPdxXXISiYW-BJ47jfvT</a>
TV /Radio	LAISDAR project and partners hold its 1st General Research Meeting	LAISDAR general research meeting	20/5/2022	National	Public awareness and dissemination	

Newspapers/Tweets	LAISDAR project and partners hold on 24th October a dissemination workshop	Dissemination workshop of longitudinal country-wide community survey	24/10/2022	National	Dissemination of key findings of the on COVID-19 in Rwanda	<a href="https://mobile.igihe.com/amakuru/u-rwanda/article/kaminuza-y-u-rwanda-mu-bushakashatsi-buzafasha-guhangana-n-indwara-z-ibyorezo#.Y1fAb2vSrOs.whatsapp">https://mobile.igihe.com/amakuru/u-rwanda/article/kaminuza-y-u-rwanda-mu-bushakashatsi-buzafasha-guhangana-n-indwara-z-ibyorezo#.Y1fAb2vSrOs.whatsapp</a> <a href="https://twitter.com/USpiu?t=losvdTRMrZt80miwnS-syg&amp;s=08">https://twitter.com/USpiu?t=losvdTRMrZt80miwnS-syg&amp;s=08</a>
News paper	LAISDAR yagaragaje uko ubwenge buremano bwafashije u Rwanda guhangamura COVID-19	LAISDAR & Predict projects dissemination and Closing research meeting	16/6/2023	National	Dissemination of the project achievements	<a href="https://mobile.igihe.com/ubuzima/article/uko-ubwenge-buremano-bwafashije-u-rwanda-guhangamura-covid-19">https://mobile.igihe.com/ubuzima/article/uko-ubwenge-buremano-bwafashije-u-rwanda-guhangamura-covid-19</a>
	Workshop evaluates UR's AI Projects' impact on Covid-19 response in Rwanda		16/6/2023	National	Dissemination of the project achievements	<a href="https://www.newtimes.co.rw/article/8312/news/featured/featured-workshop-evaluates-urs-ai-projects-impact-on-covid-19-response-in-rwanda">https://www.newtimes.co.rw/article/8312/news/featured/featured-workshop-evaluates-urs-ai-projects-impact-on-covid-19-response-in-rwanda</a>

## Section 5: Outcomes and impacts

### 5.1 AI for COVID-19 Policy and Decision-Making

#### International level:

LAISDAR project was on spotlights since the 2021 in all the “Observational Health Data Sciences and Informatics (OHDSI)” meetings and activity. The Observational Health Data Sciences and Informatics (or OHDSI, pronounced "Odyssey") program is a multi-stakeholder, interdisciplinary collaborative to bring out the value of health data through large-scale analytics. All solutions, tools, software and infrastructure from OHDSI are open-source. OHDSI has established an international network of researchers and observational health databases with a central coordinating center housed at Columbia University. LAISDAR infrastructure is seen as a pioneer initiative to harmonise fragmented data across Africa, and use them for pandemics monitoring and prevention policies; In this scope, the LAISDAR project has been on African OHDSI Chapter, as member.

#### National and Regional level

LAISDAR project created already expectations for the government and researchers in Rwanda and on African continent. Having the RBC as key partner, an implementation institution/body of Ministry of Health in Rwanda, the LAISDAR infrastructure have been highlighted as tool that can help to harmonize hospital EHRs data and re-uses them for preparedness for coming COVID-19 new waves or variants and also other emerging threats. Eg. LAISDAR was given a panel discussion in Africa CDC’s International Conference on Public Health in Africa under the “Track 6: Digitalization, Modeling and Analytics to Support an Effective Public Health Response, from Outbreaks to Pandemics and Beyond”

The LAISDAR Project has also been presented during the International Conference on Public Health in Africa (CPHIA 2022) 12-15 December, 2022).

Does this project have stories of policy and decision makers actively engaged in discussing AI applications for COVID-19 response issues at policy or other events? If yes, please provide names, dates and contexts:

Yes, the press conference for launching LAISDAR Project on February 26th, 2021 “Rwanda to use Artificial Intelligence in Covid-19 forecast” by Project promoter (Prof Marc Twagirimukiza) was leaded by Rwanda Biomedical Center (RBC), Ministry of Health, Rwanda represented by the Director General (Dr. Sabin Nsanzimana) and University of Rwanda Represented by Ag. Deputy Vice Chancellor (Dr. Emile Bienvu).

The contexts were included the Dynamics of COVID-19 in Rwanda by Highlighting the trends and its characteristics, Use of artificial intelligence (AI) and other data science (DS) techniques to analyse SARS-COV-2/COVID-19 data for dynamic, live and accurate predictions and impact of preventive measures. Among the key topic discussed was the acceptability and trust of AI algorithms, but mainly the data security.

The meeting concluded by setting up an ethical framework for data use and data sharing scheme, to be signed by all stakeholders.

Different other events/conferences, meetings have been organized and covered by media as indicated in 4.4.

Has this project contributed to build accountability and trust in AI and data science responses to epidemics, including combatting mis- and dis-information around COVID-19? Has this project

supported transparent and responsible AI, data, and digital rights governance around COVID-19 and pandemic response? If yes, please explain:

Yes, an interesting dashboard has been created and presented to policy makers and other partners in health sector. Different data science techniques have been used in research and findings have been disseminated.

Has this project contributed to strengthening data systems and information sharing about COVID-19? In particular, has it helped vulnerable communities? If yes, please explain:

Data collected from hospitals in Rwanda have been reorganized and standardized. Mapping and harmonization of hospitals data has been done and this activity is in line with strengthening health data systems in Rwanda but also play a pivotal role in supporting vulnerable communities. Mapping and harmonization of hospitals data strengthened data systems and information sharing facilitate in creating of a structured framework for collecting and storing data, integrating data seamlessly, facilitating real-time monitoring, identifying regions or communities that are disproportionately affected by COVID-19 and promoting transparency by providing clear and accessible information to the public

The organized and standardized datasets enable informed decision-making, efficient resource allocation and targeted interventions.

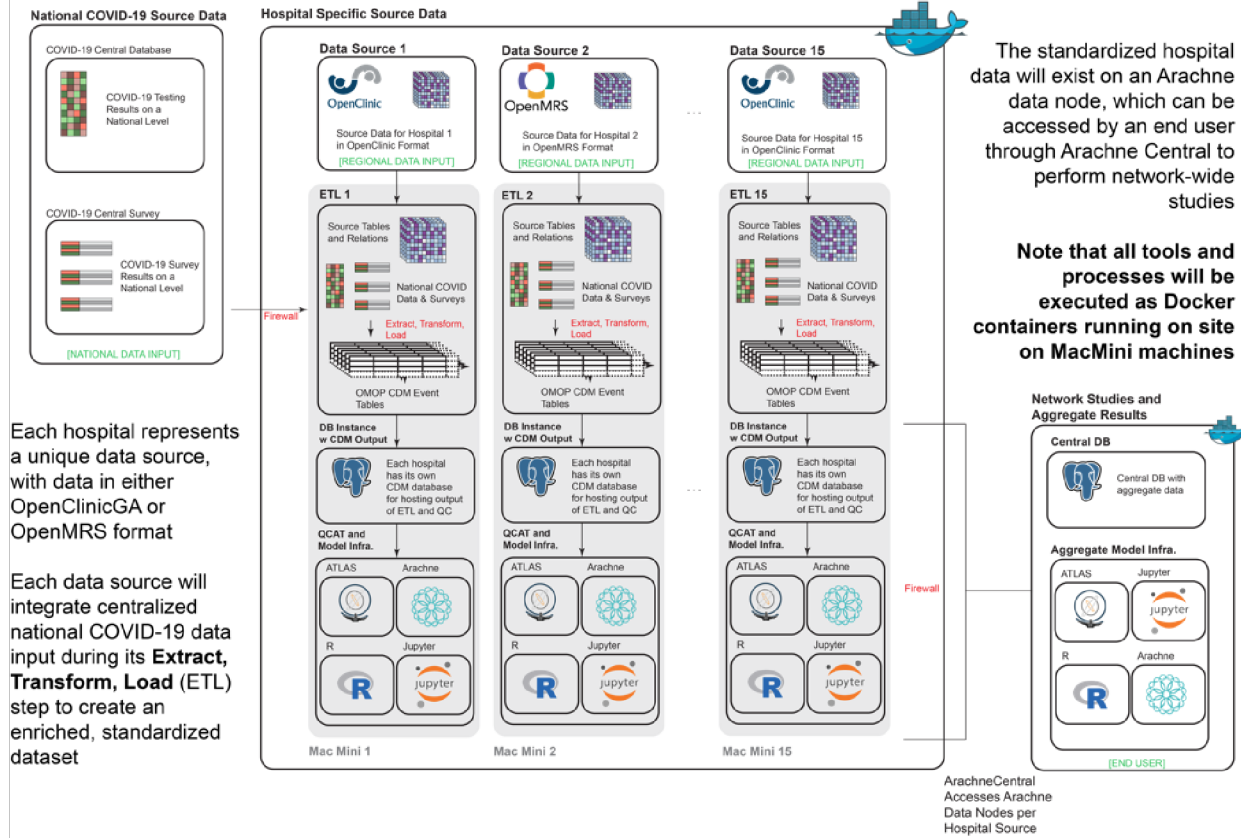
## **5.2 User-Centric Data Innovation and AI for COVID-19**

Provide the AI innovations (models, methods, etc.) developed, tested or scaled through your project. Describe how they contributed to an equitable and inclusive COVID-19 response and recovery in developing countries. What are the implications for health systems beyond COVID-19 response?

data are available yet.

The ETLs have been designed for OpenClinic GA and OpenMRS, the 2 EMRs system in use in Rwanda. The test have been done with Synthetic data from OHDSI.

## Methods

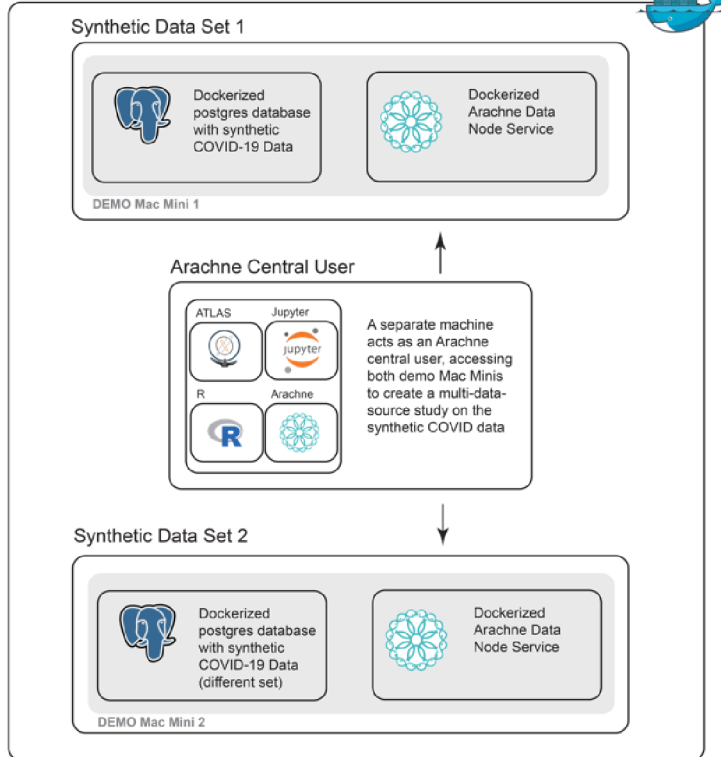


The initial methodology and design have been finetuned, updated and tested.

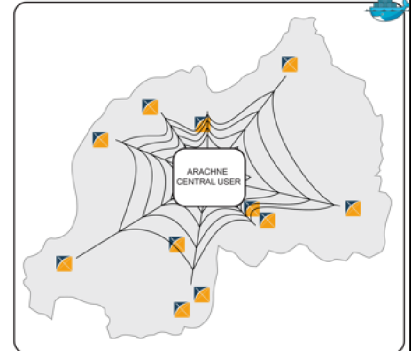
And the first prototype is being tested:

## Results

### Proof of Concept



### Rwanda-Wide Network Studies



- The two demo machines have been configured to run the necessary dockerized processes for hosting a CDM instance with synthetically generated COVID-19 data and an Arachne Data Node
- Machines are *en route* to Rwanda, where they will be used for a network-wide training session for the data managers at the particular source locations
- Following the demonstration and training (end September 2021), the remaining Mac Minis will be configured and shipped to their respective locations to establish the national data network
- ETL development is in progress and code will be finalized and deployed at each data location

This research applied the machine learning models provided by ML.Net to build AI key influencers that provide insights and statistical figures about the following:

- Key influencers for Mental health status such as Depression, and Anxiety
- Key influencers of Covid-19 spreading based on the observation of preventive measures
- Domestic Violence and associated factors during COVID-19 in Rwanda: A country-wide longitudinal study. The paper assessed the behaviors associated with domestic violence among partners and parents towards their children during the period of Covid-19.
- Assessment of the socioeconomic impact of COVID-19 in Rwanda: Findings from a country-wide community survey. This study describes the interplay between multiple factors to assess the socio-economic impact of COVID-19 on the Rwandan population at micro-level (household).
- Modelling and Forecasting of COVID-19 New Cases in Rwanda Using Reproduction number ( $R_t$ ) based Bayesian approach. In this study, we developed statistical models that can predict new cases and real-time reproductive numbers to serve as an early warning tracking system for new infections. The prediction models incorporate vaccine coverage and SARS-CoV-2 variant dynamics to improve accuracy



The forecasting models have been applied to study how Mental health status trends in the future, based on different parameters provided in the dataset. The forecast showed a stable decrease in depression and anxiety levels. This is due to various measures put in place and other related factors.

AI Key influencers were also applied to have a deep understanding of how different prevention measures affect the spread of Covid-19. The top influencers that cause Positive or Negative outcomes were identified.

In general, the above-mentioned AI models can be applied to various similar contexts.

In addition to this, this research applied various supervised learning models for predicting the potential future occurrences of COVID-19. In this context, KNN was found to be the most relevant based on the dataset at hand. The model once deployed can help in the prediction of new positive cases and can also be applied to various problems of the Similar context

The models implemented were tested using data from the collected dataset.

Has this project contributed to more efficient and accurate forecasting of transmissions and reducing spread through policy and public health interventions (e.g. vaccine rollouts)? If yes, please explain:

One of papers developed was on “A Bayesian approach for monitoring COVID-19 and Forecasting of New Cases: Rwanda experience”. Real-time reproductive number ( $R_t$ ) of COVID-19 was estimated. The Poisson model and Linear Regression model were employed to gain insights into how various influencing factors impact the prediction of case counts and  $R_t$  values. Lockdown and the two doses of the Vaccine have a significant effect in both models. Conversely, the variable "Week" displayed a relatively lesser impact on the predictive outcomes. Findings from this paper can be used for policy and public health interventions.

Has this project contributed to optimising public health system responses for patient diagnosis, care, and management? If yes, please explain:

No

Has this project contributed to a deepened understanding of the social impacts (positive and negative) of AI innovations in developing countries? Has it generated lessons learned and best practices in how to design and scale responsible AI innovations that are gender responsive and culturally appropriate, community specific, and based on local needs and contexts? How are these learnings applied or used?

This project has significantly in understanding the social impacts. Research findings demonstrate the effects of COVID-19. Some of papers developed are on:

- Domestic Violence and associated factors during COVID-19,
- Socioeconomic impact of COVID-19,

- Depression, anxiety and mental well-being during the COVID-19 pandemic.

Provide the number of private sector actors (start-ups, consultancies, private companies) involved in the development, testing or scaling up of AI innovations. Specify their name and how they are involved.

LAISDAR project involved by design multiple partners including EdenceHealth NV (Belgium) which is a private health technology company; and the RASD Rwanda which is Rwanda NGO handling the community outreach in LAISDAR on top of overall project management activities.

### 5.3 Cross-cutting objectives

#### Capacity strengthening

The project has organized different learning activities including Conferences and workshops:

##### **1. Workshop of 2 days for Participating Health facilities**

The Physical workshop for the health facilities/hospitals participating in the project took place at Musanze for 2 days from 22 to 23 April 2021. 15 hospitals were invited, each represented by its Director General and IT Manager. LAISDAR project was represented by the PMO, Lead PI and RBC team.

The main objective of workshop was to introduce the LAISDAR project to the hospital Director Generals, heads of health centres and the staff in charge of COVID data, explore the needs and capacity of each facility to participate in the LAISDAR project and align the project implementation to their respective needs. Following are specific objectives and outcomes:

- To share the overall objectives & expected results of LAISDAR project
- EMR, Covid 19 systems & Open Clinic integrations architecture and devices
- Call for support on: Availing data (complete patients' diagnosis, procedures, Lab tests and medicine), Ensure uniqueness of patients' ID in HF, Data backup (taken daily), Sign off Data Sharing Agreement with RBC.
- To listen to the heads of the hospitals/health facilities regarding their unmet needs in hospital data digitalisation (5minutes each) and evaluate each facility readiness to participate to the LAISDAR project.

##### **2. 1st Biannually LAISDAR Consortium Monitoring Workshop**

From June 7-8, 2021 LAISDAR project, UR-CMHS hosted the 1st Biannually LAISDAR Consortium Monitoring Workshop at Musanze. The overall goal of the workshop; to track the project activities progress and to identify the strategies to overcome challenges and timely implement the upcoming tasks, The 1st 6 months period of the Project evaluation and adjust the future plans. 17 members were invited including PMO staff, MPs and Lead PI and the Project promotor; 6 were female (35%) and 11 male (65%). Among the discussed issue includes; General overview of the LAISDAR Project, Implementation Report for all activities per work packages (last six months), Future plans per work packages (next six months), Challenges faced in the implementation process, The burning issues that needed to be addressed as soon as possible and the way forward.

##### **3. The 2nd Biannually LAISDAR Consortium Monitoring Workshop**

From 21st -22nd January 2022, LAISDAR project in collaboration with the University of Rwanda hosted the 2nd Biannually LAISDAR Consortium Monitoring Workshop at Musanze CAVEM Campus. The main objective of the workshop is to track the progress of the project activities and to identify the strategies to overcome challenges and align the project implementation plans with identified needs. 24 members

including the PMO staff were invited. 12 members attended the workshop (4 were female and 8 males). The progress of activities as per work package, challenges, pending tasks and future plan

#### **4. LAISDAR- General Research Meeting**

On May 20th 2022, the UR-CMHS hosted the LAISDAR- General Research Meeting at Serena Hotel. It was chaired by the project lead principal investigator, Prof. Charles Ruranga. Participants were from institution partners (RBC, CHUK, RASD& UR, Edence Health), PMO staff and 1 participant from the inspire project. Among 39 participants, 10 were female and 29 males. The main objective of this meeting was to share the overall project progress, achievement, discussing about the challenges encountered, seeking advice and guidance on how to overcome them, and planning the future steps towards the project outcome.

#### **5. 2nd Publication workshop**

From 18- 20 July 2022, The LAISDAR project held a 2 days publication workshop at Musanze CAVM Campus. Participants attended physically and online (7 males & 7 females). The purpose of this workshop was to discuss and analyze 14 topics identified. During the workshop, participants had a common understanding on available dataset ,2 manuscripts were drafted and other 2 manuscript have been shared on google doc for member to work on them.

#### **6. Physical workshop for publication (Gender team)**

On 23rd August 2022, the team working on gender paper had a meeting aimed at working on gender manuscript titled “Gender based violence and COVID 19 in Rwanda. 6 females and 1 male attended the workshop. They were able to discuss the section of the manuscript, finalize the working plan and shared responsibilities.

#### **7. Physical workshop for publication (Socio economic team)**

On 13th September, the team working on Socio economic paper held a one-day workshop at UR Gikondo Campus. 7 females and 6 males attended the workshop. The purpose of the workshop was to work on socio economic manuscript titled “Socio economic impact of COVID 19” Team members discussed on the progress of Manuscript and worked on analysis of the manuscripts.

#### **8. Training of ITs from 15 Hospitals**

On January 27th 2023, the ITs of concerned hospitals had a physical training about connection and ETL deployment of Macminis. The training took place in CHUK

#### **9. Physical Publication Research Workshop**

From February 20th to February 22nd 2023, the LAISDAR team ( PI, Investigators and PMO) had a workshop in UR- CAVM , Busogo campus to work on papers for publication.

#### **10. Physical Publication Research Workshop**

On March 20th to 22nd 2023, the LAISDAR team (PI, Investigators and PMO) had a workshop in UR- CAVM, Busogo campus to work on papers for publication

#### **11. 4-day Physical workshop of ITs held in CAVM (Busogo Campus)**

From April 17 to April 20, 2023 IT staff from 15 HFs gathered at Musanze for a workshop. The aim of the workshop was to train hospitals ITs on hospital data harmonization output, to handle the data requests and to effectively use MacMini’s workstations installed in their respective hospitals

#### **12. Physical Publication Research Workshop**

April 26th to April 28th 2023, the LAISDAR team (PI, Investigators and PMO) had a workshop in UR- CAVM, Busogo campus to work on papers for publication’

#### **13. Physical Publication Research Workshop**

From 15th to May 19th 2023, the team of investigators gathered at Musanze to work on pending papers (track 2) and finalize the papers in track 2.

#### **14. Physical local workshop**

From 19th -23rd June 2023, LAISDAR Team and PMO hold a meeting at Musange to work on the closure report of both LAISDAR and Predict projects. They have also worked on Mental Health Paper.

Has this project supported emerging researchers and early career academics to be trained and build their leadership skills? Have some benefitted from new knowledge and skills acquired through this project to advance in their careers? If yes, please explain.

Emerging researchers have been involved in all research activities of the project including weekly research meetings, publication writing trainings, data collection, cleaning and analysis and manuscripts writing and submission for publication.

***List of Emerging researchers in LAISDAR Project***

No	Names	Gender
1	Aurore Nishimwe,	Female
2	Clarisse Musanabaganwa	Female
3	Regine Mugeni	Female
4	Muhammed Semakula	Male
5	Jean N. Utumatwishima	Male
6	Odile Bahati	Female
7	Clement Bizimana	Male
8	Elias Mutezimana	Male
9	Viviane Akili	Female
10	Laurence Twizeyimana	Female

IT officers from hospitals and other staff have been trained from 17<sup>th</sup> to 20<sup>th</sup> April 2023 on hospital data harmonization, how to handle the data requests and how to effectively use MacMini's workstations installed in their respective hospitals.

***List of Participants in training***

No	Names	Position/institution
1	Nsengimana Isidore	IT Officer, Kibagabaga Hospital
2	Irityaye Aimee Merveilleuse	IT Officer, Rwamagana Hospital
3	Mapendano Emmanuel	IT Officer, Rugengeri Hospital
4	Musemakweli Ezechiel	IT Officer, Kigeme Hospital
5	Nyirimana Jean Claude	IT Officer, Kirehe Hospital
6	Nkundimana Xavier	IT Officer, Muhima Hospital
7	Gatera Jean Damascene	Director of ICT, CHUB
8	Byarugaba Evode	IT Officer, Nyagatare Hospital
9	Sezirahiga Eugene	IT Officer, Nyamata Hospital
10	Buyenge Maxime	IT Officer, Kibungo Hospital
11	Uwayezu Diane	IT Officer, Gihundwe Hospital
12	Elias Mutezimana	Data Science Specialist, African Center of Excellence in Data Science, University of Rwanda
13	Mukazi Alpha	IT internee, African Center of Excellence in Data Science, University of Rwanda
14	Mukamuhire Henriette	Data Manager, Ntarama Health Center
15	Nkurunziza Innocent	IT Officer, Gisenyi Hospital
16	Gilbert Rukundo	RBC

## 5.4 Positioning for sustainability

Has this project helped your organisation (or consortium partners) to be recognized as a leader in the AI and data science or public health fields? If yes, please explain.

Yes, based on this project university of Rwanda especially in the African Centre of Excellence in Data Science (ACE-DS) has been recognized as leader in the AI and data science. ACE-DS has been involved in many activities at national, regional and international levels. There are many activities where the center is involved some instance:

- Attending the Inter University Council for East Africa (IUCEA) 14th annual conference and give speech on “Quality Assurance and the Opportunities and Challenges of AI on Higher Education”, 27th June 2023 in Kigali, Rwanda.
- Invited in the Innovate Africa Symposium, themed “Ideating partnerships to enable data driven government agencies” to be held from October 25-27, 2023, in Johannesburg, South Africa.
- Participation in Biotech Future Forum 2022 themed “Biotechnology and its impact on shaping the future”, 20-21 October 2022, Belgrade, Serbia.

Has this project helped team members or affiliated researchers to be recognized as thought-leaders and called upon for their inputs? If yes, please provide names, dates and contexts.

Yes, for example, Lead PI of LAISDAR Project Prof. Charles Ruranga has been invited by the Inter University Council for East Africa (IUCEA) to be Panel presenter on “Quality Assurance and the Opportunities and Challenges of AI on Higher Education” in the 14th annual conference organized on 27th June 2023 in Kigali, Rwanda.

Describe any new or ongoing collaborative arrangements you have developed with other institutions or key stakeholders. This can include collaborations with other AI4COVID institutions, with multi-lateral institutions, etc. in part or in whole from advancing this project. Comment on the usefulness of these partnerships/collaborations in achieving the project’s objectives and how it can help the sustainability of activities post project completion.

The project-initiated contacts with different other research teams including:

1. The team from Cheikh Anta DIOP University of Dakar. The team with the support of the University of Ottawa and CERCAD (Mali), has been awarded a grant under the "AI4 COVID PROGRAM" for countries of the South in response to COVID-19, co-financed by IDRC and the Swedish International Development Cooperation Agency (SIDA). Their research project "Uses of Artificial Intelligence (AI) in the fight against COVID-19: Local Adaptability and Social Acceptability for Ethical and Responsible AI (SENEGAL AND MALI)" aims to inform policies that support and strengthen confidence in artificial intelligence, one of the essential levers in the response to epidemics. LAISDAR investigators participated in the Launching Webinar on Wednesday 20 January 2020.
2. Global South AI4COVID Program awardees: The INSPIRE project – led by Sylvia Muyingo in APHRC which has some areas of commonality with LAISDAR project – The use of AI and data science for harmonising, sharing, accessing and analysing COVID-19 data. Our project is looking at Rwanda, whereas INSPIRE is concentrating on the data from Malawi and Kenya.

The initial contact done with Jim Todd (LSHTM).

3. Local stakeholders building synergy with other modelling projects in Rwanda and beyond:
  - 3.1 Carnegie Mellon University -Africa: Their research team initiated the "Managing Pandemics" project funded by MasterCard Foundation with aim of modelling. LAISDAR investigators held already 2 meetings with their team to explore potential synergy in our modelling techniques.
  - 3.2 The Rwanda National Council of Science and technology grant recipients (exploration phase)
4. Pulse Lab Jakarta (contacts with Sriganesh Lokanathan )-In their efforts to support all the Global South AI4COVID Program awardee: The LAISDAR WP6 lead (Dr Regine Mugeni) shared the LAISDAR blog to be published on the global communication web. Additionally, the contacts were made with Gender Work and Ladysmith Collective which led the gender component of the technical support.