dd

Attachment F
Covid-19 Grant Outcomes and Accomplishments Final Report

To finalize this award, you are required to provide to the Agency with a narrative of the outcomes and accomplishments related to the funds spent for the specific purpose as stated in the grant contract. You can use the secure link provided below to upload images, brochures, and other information to illustrate your outcomes and accomplishments.
https://ncosbm.sharefile.com/r-rc7f2ca49d574af2a

1. Organization:	
Organization Name:	North Carolina Policy Collaboratory at the University of North Carolina at Chapel Hill

North Carolina Central University-23-01-05 Attachment

2. Outcomes and Accomplishments:
Attached are the ACCORD PI's individual COVID-19 Grant Outcomes and Accomplishments Final Reports.

Attachment F ACCORD Final Report

PI Names: Tanisha Burford, Ph.D. and Charity S. Watkins, Ph.D.

Project Title: The Pandemic of Stress: An Examination of the Relations among Occupational Status, Perceived Stress, Self-Rated Health, and Sleep during COVID-19

Description of project:

Background: Acute and chronic psychological stresses contribute to adverse behavioral and health outcomes with racial minorities (e.g., African Americans) and those of low SES reporting higher levels of acute and chronic stress experiences. Given the precarious employment status of African Americans and the significant patterns of change in both employment status and economic standing/wages, it is important to understand how employment status during COVID-19 predicts perceptions of stress. In addition, because perceptions of stress impacts sleep, which is risk factor for cardiovascular disease, it is important to understand the associations between perceived stress and sleep across employment status, and the relations among employment status, perceived stress, self-rated health, and sleep.

Specific Aims:
Aim 1: To examine differences in perceived stress among essential and non-essential workers.
Aim 2: To determine if differences in occupational status predict self-rated health.
Aim 3: To determine if differences in occupational status predict sleep disturbances.
Aim 4: To test the interactional association of occupational status and perceived stress on self-rated health.

Strategy: A study sample of 160 African American adults (ages 18 and over) were recruited from Durham County and surrounding rural counties in North Carolina (i.e., average population density of 250 people per square mile or less). Participants completed a web-based survey that obtained demographic information (e.g. race, gender, age, occupation and employment status) and assessed perceived stress, self-rated health, and sleep. Participants who meet inclusion criteria for the study will receive a $10 eGift card upon completion of the survey. A 3-month follow-up survey (same as the initial survey) will be sent out to participants via email to determine if patterns of change in employment status, hours, wages differential predict perceived stress, sleep, and self-rated health, and health outcomes.

Goals and Tasks of Project

- Recruit a study sample of 160 African American adults (e.g., ages 18 and over) from Durham County and surrounding rural counties with an average population density of 250 people per square mile or less through paper and online distribution of recruitment flyers to community-based agencies and through professional networks. The assistance of the RCMI Community Engagement Core will also be sought for recruitment efforts.
- Develop a web-based (Qualtrics) survey that obtains demographic information (e.g. race, gender, age, occupation and employment status) and assesses perceived stress, self-rated health, and sleep. Include the survey web link in the recruitment flyer in efforts to expedite data collection.

- Use t-tests analyses to examine differences between essential and non-essential worker status on perceived stress, self-rated health, and sleep disturbance. Use hierarchical linear regression and structural equation modeling techniques to assess the relations among occupational status, perceived stress, self-rated health, and sleep using Stata 13 and Mplus 8.4 statistical software.
- Administer a 3-month follow-up online survey with participants who consented to being contacted in the future in order to analyze patterns of changes in employment and/or occupational statuses predict perceived stress, self-rated health, health problems, and sleep. Participants will receive a $20 eGift card upon completion of the follow-up survey. We seek to include at least 96 participants in the 3-month follow-up in order to achieve a 60% retention rate.

Outcomes

The study's recruitment strategies were very successful yielding the completion of more than 1,000 online surveys. In conjunction with graduate student assistants, data cleaning is underway to ensure data from survey participants who meet the inclusion criteria are included in analyses. Disbursement of the eGift card incentives will also occur once data cleaning is complete and a final sample size is confirmed for the study. Data analyses will be conducted within 8 weeks in efforts to move towards data dissemination (i.e., conferences, publications, community events).

ATTACHMENT C-1

PI Name

Undi Hoffler, Ph.D.

Project

SA2 Messaging Development Core

Provide a descriptive summary of how the funds were used.

Production expenses for the ethnodrama have been expended in the amount of $8,350.00. Remainder of the Jomoworks, LLC contract has been submitted for $2000.00.

Provide specific deliverables achieved.

- Printed and distributed inaugural ACCORD newsletter.
- Executed partnership with NC DHHS, https://www.ncdhhs.gov/news/press-releases/ncdhhs-announces-new-partnership-nccu-enhance-covid-19-outreach-efforts-among
- Executed partnership with Lumbee Tribe and UNC-Pembroke, https://www.nccu.edu/news/nccu-unc-pembroke-lumbee-tribe-launch-testing-initiative-sandhills
- Conducted inaugural ACCORD Virtual Townhall on Dec 17th featuring community facilitators focusing on Tier 1 and Tier 2 participating counties.
- Participated in WUNC podcast for discussion about the upcoming COVID-19 ethnodrama.
- Distributed pre-survey link to the public to collect baseline data prior to airing of ethnodrama.
- Broadcast using Vimeo (additional stream on NCCU_ACCORD Facebook), "A Crisis of Moments" COVID-19 ethnodrama and live panel discussion, over 600 views through Dec 30th.
- Distributed post-survey link to participants completing the pre-survey following ethnodrama and panel presentation.
- Continued to build additional partnerships with faith-based and community organizations in support of SA1 to highlight the importance of testing and hearing directly from communities hardest hit by COVID-19 (survey data).
- Twitter handle @nccu_accord reached 37,372 impressions, 190 tweets posted, and total profile visits, 1,456.

Progress against objectives and outcomes expected to be achieved.

SA2 Messaging Development Core	Objectives Completed	Overall Expected Outcomes
Social Media Dissemination	100%	Disseminate data and findings from COVID-19 pilots and projects conducted under SA2 through social networks. Position paper publication based on situational analysis of COVID-19. Drive and establish a partner network to leverage the shared voice of reliable public and community health organizations. Create and post ACCORD generated and produced messaging. Organize community-led virtual town halls with community facilitators.
COVID-19 Ethnodrama	100%	Assessment of knowledge, attitudes, and behaviors of participants towards COVID-19: 1. Effectiveness of the ethnodrama in evolving/informing perceptions of the disease, testing, clinical trials, and vaccinations; 2. Motivation to share one's experience viewing/participating in the ethnodrama and panel with others; 3. Motivation to seek additional information about COVID-19 and its short- and long-term impacts (physically, emotionally, financially, relationally); 4. Influence of the ethnodrama to reinforce or change one's practices towards personal safety and the safety of others; and, 5. Assessment of associations between attitudinal change and sustained changes in behavioral practices.

What performance metrics are you using to show us how the CRF funds are helping you achieve your recovery goals.

Attachment F ACCORD Final Report

PI Name Nina Smith

Project Title Covid 19: Impact on Black Families

Description of project. This project aims to assess 'real-time' impacts of COVID within Black households residing in rural and urban North Carolina communities. I am particularly interested in understanding how COVID has shaped mental health, daily routines, parent-child interactions, employment status, and food security among families with children. All households have at least one child under the age of 18. I recruited from 5 NC counties – Cabarrus, Durham, Guilford, Halifax, and Wake.

Goals and Tasks of Project This study seeks to achieve the following aim:

Aim 1: Conduct a community health assessment of Black parents living in rural and urban North Carolina communities.

Activities. 1. Conduct a longitudinal survey to explore associations among health status, parent-child interactions, parental stress, perceived support, and food sufficiency amid the COVID-19 pandemic.

Primary tasks entailed recruiting participants, data cleaning, data analyses, and manuscript preparation. My target number of participants was 100.

Outcomes To date, I have recruited 28 participants (approximately one-third of my target). In an effort to gain a deeper understanding of participants' experiences during the pandemic, I have collected qualitative data through focus groups with a subset of 10 participants. Preliminary findings suggest that Covid-19 is impacting Black families in the following ways:

- Job Loss
- Disrupted Family Routines
- Food Insecurity
- Increased Social Support

Attachment F ACCORD Final Report

PI Name: Weifan Zheng, Ph.D., Associate Professor, Department of Pharmaceutical Sciences, College of Health and Sciences, NC Central University.

Project Title: Drug Repurposing for COVID19 Using Data Mining and Machine Learning Technologies

Description of project.

In this project, ***we hypothesize that a systematic survey of PubMed with the aid of machine learning-driven text mining technology would afford a better yield for potential drugs against COVID19*** based on our recent successes of using it for IBC (inflammatory breast cancer) and P53-interacting kinases. Here, we have adopted the text mining technology *Word2Vec* (first developed by Google's AI team for general text analysis) and a machine learning tool called Support Vector Machine (SVM) to analyze the biomedical literature to discover hidden associations among known drugs, targets and diseases, and to identify new candidates for COVID19.

Goals and Tasks of Project: This project involves three Specific Aims as follows.

Aim 1 is to collect and organize the PubMed abstracts before we initiate the text mining technology Word2Vec to analyze the abstracts.

Aim 2 is to conduct Word2Vec analysis of the above corpus to obtain quantitative representation of drugs and diseases, including COVID19 and FDA-approved drugs.

Aim 3 is to conduct machine learning modeling (both Support Vector Machine and multi-layer perceptron) analysis. The models have been used to search for potential drugs for COVID19.

Outcomes

- Word2Vec analysis of the biomedical literature (PubMed) has been collected and analyzed to obtain the quantitative representation of biological concepts (drugs, diseases and targets).
- T-SNE visualization plots of all analyzed drugs and diseases have been generated.
- Various machine learning models have been developed to be predictive of drug-disease pairs.
- The machine learning validated models have been employed to search for potential drug candidates for COVID19. Several of these candidates have been retrospectively validated by searching current literature (PubMed) for relevant information.
- A list of top scoring drug candidates has been generated and is being evaluated with literature information
- A manuscript is being prepared for submission to drug repurposing related Journal.

Hyperparameter Selection

The hyperparameters, C and gamma, have been tested for model development and validation. A variety of combinations of C and gamma have been tested and the AUC values are reported in Table 1.

Table 1 – Model development using Support Vector Machine (SVM) for Drug-Disease Pairs

Dataset-1 SVM Tuning			
C	gamma	AUC_Train	AUC_Test
1	0.001	0.902	0.871
	0.0001	0.739	0.774
10	0.001	0.994	0.908
	0.0001	0.815	0.791
50	0.001	1	0.911
	0.0001	0.885	0.801
100	0.001	1	0.909
	0.0001	0.922	0.823
200	0.001	1	0.908
	0.0001	0.954	0.857
300	0.001	1	0.908
	0.0001	0.971	0.877
400	0.001	1	0.908
	0.0001	0.98	0.885
500	0.001	1	0.908
	0.0001	0.984	0.886
600	0.001	1	0.908
	0.0001	0.987	0.886
700	0.001	1	0.908
	0.0001	0.989	0.885
800	0.001	1	0.908
	0.0001	0.99	0.884
900	0.001	1	0.908
	0.0001	0.991	0.884
1000	0.001	1	0.908
	0.0001	0.993	0.883
3000	0.001	1	0.908
	0.0001	0.999	0.885
5000	0.001	1	0.908
	0.0001	1	0.881
10000	0.001	1	0.908
	0.0001	1	0.877

Model Quality

Ten sets of training data have been generated, each of which was split into 80% for training and 20% for testing. The trained models have been used to predict both the training set drug-disease pairs and the test set of drug-disease pairs. Standard ROC curves have been generated for both the training sets and test sets. Areas Under the Curve (AUC's) have been calculated to indicate the model quality (Table 2). Both SVM and ANN have obtained high performances as can be seen in Table 2.

Table 2 – SVM and ANN model quality statistics (AUC: Area Under Curve).

	AUC			
	SVM		ANN	
Dataset	Train	Test	Train	Test
Dataset 1	0.996	0.941	1.000	0.943
Dataset 2	0.995	0.947	1.000	0.947
Dataset 3	1.000	0.947	1.000	0.949
Dataset 4	1.000	0.944	1.000	0.947
Dataset 5	1.000	0.942	1.000	0.938
Dataset 6	1.000	0.948	1.000	0.954
Dataset 7	1.000	0.945	1.000	0.947
Dataset 8	0.994	0.943	1.000	0.938
Dataset 9	0.995	0.951	1.000	0.954
Dataset 10	1.000	0.936	1.000	0.942

Thirty candidates have been identified that could be potential COVID19 drugs

The sum of the first 30 predicted drugs by each of the ten models form a set with 130 unique predicted drugs. The table below shows the top 30 drugs with the frequency for each of their occurrence. Many of this list are antibiotics and anti-inflammatory drugs, which make sense in that SARS-CoV2 causes inflammation and may also need antibiotics to stop potential secondary infections that may be caused by bacteria in the tissues. The fact that many of the drugs appeared in majority of the model predictions indicates the stability of our models.

Table 3.

Top 30 predicted drugs for COVID19 and their occurrences (F) in the 10 predicted sets					
	H-ID	D-ID	Disease	Drug	F
1	H02398	D00290	COVID-19	Demeclocycline hydrochloride	9
2	H02398	D00850	COVID-19	Minocycline hydrochloride	8
3	H02398	D03903	COVID-19	Doxycycline calcium	8
4	H02398	D00978	COVID-19	Hydrocortisone sodium succinate	7
5	H02398	D00751	COVID-19	Methylprednisolone sodium succinate	7
6	H02398	D05408	COVID-19	Penicillin G sodium	7
7	H02398	D02157	COVID-19	Penicillin G benzathine	7
8	H02398	D00981	COVID-19	Prednisolone sodium phosphate	7
9	H02398	D02461	COVID-19	Penicillin G procaine	7
10	H02398	D02115	COVID-19	Methotrexate sodium	7
11	H02398	D01053	COVID-19	Penicillin G potassium	6
12	H02398	D00587	COVID-19	Sulfadiazine	6
13	H02398	D00975	COVID-19	Dexamethasone sodium phosphate	6
14	H02398	D02185	COVID-19	Chloramphenicol sodium succinate	6
15	H02398	D02122	COVID-19	Tetracycline hydrochloride	6
16	H02398	D00307	COVID-19	Doxycycline	5
17	H02398	D00292	COVID-19	Dexamethasone	5
18	H02398	D00285	COVID-19	Co-Trimoxazole	5
19	H02398	D00472	COVID-19	Prednisolone	5
20	H02398	D00983	COVID-19	Triamcinolone acetonide	5
21	H02398	D00473	COVID-19	Prednisone	4
22	H02398	D11922	COVID-19	Atoltivimab, maftivimab and odesivima	4
23	H02398	D05384	COVID-19	Pegademase bovine	4
24	H02398	D08483	COVID-19	Rimantadine	4
25	H02398	D00736	COVID-19	Trientine hydrochloride	4
26	H02398	D02129	COVID-19	Doxycycline hyclate	4
27	H02398	D02094	COVID-19	Thiamine hydrochloride	4
28	H02398	D07441	COVID-19	Amantadine	4
29	H02398	D00407	COVID-19	Methylprednisolone	3
30	H02398	D02735	COVID-19	Rimabotulinumtoxin B	3

Attachment F: ACCORD Final Report

PI Name: Elizabeth R Tomlinson

Project Title: HBCU Nursing Students' Perspectives, Experiences, and Professional Outlook Related to COVID-19

Description of project:

The global COVID-19 pandemic has illuminated widening health disparities, social infrastructure deficits, and health care system failures in the United States. Health care workers are one of the most profoundly affected demographics, and nurses spend the most time providing direct patient care than any other health profession. Inadequate staffing, benefits, and personal protective equipment have generated feelings of fear and mistrust among health care providers, while misinformation about COVID-19 and pandemic response has generated similar feelings among U.S. citizens. Healthcare workers and already-disadvantaged Americans continue to be profoundly affected by the ongoing crisis of COVID-19, and meaningful solutions to improve their outcomes remain uncertain.

The swift transition to online learning environments has had particularly meaningful effects for students in disciplines like nursing, which require students to master kinesthetic clinical skills. Nursing students can offer a unique perspective on the education and socialization needs of pre-licensure students, safe and effective nursing education in the pandemic context, and the role of novice nurses entering the health care work force. Nursing students from HBCUs can offer valuable perspective on COVID-19 related health disparities, the diversification of the nursing workforce, and the professional outlook of novice nurses entering the profession during an unprecedented global health crisis.

This study combined mixed survey and focus group methods. Survey methods will assess stress and coping, resilience, and satisfaction with learning and will also collect data on open-ended questions related to COVID-19. Focus groups will gather narrative data on student perceptions regarding the pandemic, their professional outlook, and community and social concerns. Findings from this study will provide valuable evidence on the adaptation of nursing education during the COVID-19 pandemic, as well as the attitudes of novice nurses preparing the enter the healthcare workforce during this unprecedented global health crisis.

Goals and Tasks of Project

The aims of this study were to:

1. Measure satisfaction with education, professional values, resilience, and COVID-19-related fears, stressors, and behaviors among HBCU nursing students, and
2. Describe the educational experiences, professional outlook, and community concerns of HBCU nursing students during the COVID-19 pandemic.

My goal was to recruit at least 60 survey respondents and 20 focus group participants. I anticipate that findings from this study will be publishable in nursing education and/or community health nursing journals.

Outcomes:

As of February 9 2021, 65 survey responses had been recorded in Qualtrics. Focus groups are planned for late Spring 2021. Survey data analysis has not been completed, but preliminary analysis follows:

- Seventy-six percent of respondents identified as Black or African American, 11% identified as white, 7% identified as Hispanic or Latinx, and 6% identified as Asian.
- Forty-seven percent reported that their primary job was in healthcare (e.g. Certified Nurse Assistant) and 67% worked in an "essential" field during the COVID-19 pandemic.
- *Perceived Stress Scale:* Mean overall score for the PSS (item range 1 to 4) was 69.54; the possible score range is 0 to 116. The overall mean item value was 2.318, higher than perceived stress reported by nursing students beginning clinical practice in a 2002 study (mean = 1.75; Sheu, Lin & Hwang).
- *COVID-19 Related Stressors Checklist:* Only one respondent reported being diagnosed with and treated for COVID-19, though 42% had been quarantined with suspected COVID-19 and 15% had experienced COVID-19 symptoms. Notably, 81% reported that their progress at work or school was affected by COVID-19. Other stressors included cancelled travel (75%), being unable to engage in previously enjoyed activities (94%), unable to socialize with friends and family (90%), difficulty buying groceries or other necessities (54%). Three respondents reported the death of a family member due to COVID-19 and 37% reported a family member being ill with COVID-19. Twenty-three percent reported a close contact (friend, boyfriend/girlfriend, partner) was diagnosed with COVID-19, 40% reported that an acquaintance died from COVID-19, and 77% reported that an acquaintance was ill with COVID-19.
- *COVID-19 Perception of Threat:* Eighty percent of respondents either agreed (40%) or strongly agreed (40%) that their nursing job placed them at great risk for contracting COVID-19. Sixty percent felt more stress at work or clinical practice than before the pandemic, 75% felt afraid of falling ill with COVID-19, yet most (95%) did not feel they had little chance of survival if infected and 53% felt they had at least some control over whether they became infected.. Fifty percent reported that they accepted the risk of caring for COVID-19 patients and only 10% reported thinking of quitting or resigning from work or clinical because of COVID-19. Many (71%) reported fear of passing COVID-19 to friends, family, colleagues or patients and 48% reported that their friends or family worried about being infected through contact with them.
- *Willingness to Provide Care*: Seventy-six percent of respondents were willing to work as a nurse during the pandemic, and most felt knowledgeable about COVID-19 (81%) and able to safely care for COVID-19 patients (66%). A slim majority (56%) agreed that their primary employer would ensure nurse safety and family safety (54%).

ATTACHMENT C-1

PI Name William Pilkington

Project ACCORD Strategic Aim 1

Provide a descriptive summary of how the funds were used.

ACCORD has conducted testing at 52 sites in the nine counties of Anson, Cabarrus, Durham, Granville, Halifax, New Hanover, Rowan, Vance and Warren. Six of these counties are categorized as Tier 1 economically distressed counties.

Provide specific deliverables achieved.

Through December 31,2020, ACCORD has provided COVID-19 testing for 3,276 persons and collected and analyzed 1,355 surveys on attitudes toward COVID-19 testing and vaccinations. The results indicated major findings on vaccine hesitancy in historically marginalized populations with a consistent trend toward vaccine acceptance throughout the life of the ACCORD project.

Progress against objectives and outcomes expected to be achieved. The ACCORD goal for Strategic Aim 1 was 200 COVID-19 tests and in each of the nine counties. That goal has been exceeded in all nine counties.

What performance metrics are you using to show us how the CRF funds are helping you achieve your recovery goals.

For Strategic Aim 1, the performance metric was 1800 total tests and 1,000 surveys collected. Both of these have been exceeded.

Attachment F ACCORD Final Report

PI Name

Christopher Paul, S. Nicole Diggs, Dohyun Lee

Project Title

The Role of Food Security in the Social Determinants of Health: Contingent Impacts of COVID-19 in North Carolina

Description of project

This study investigated the broad effects of food insecurity at the household and community level during the COVID-19 crisis in North Carolina. The crisis caused by the COVID-19 pandemic is exacerbating existing disparities in the social determinants of health, notably racial, economic, and geographic disparities through pathways such as food insecurity.

This project had three primary methods to understand food security during the COVID-19 pandemic in North Carolina: 1) household surveys, 2) geospatial mapping, and 3) organizational interviews. For the household surveys, we used a rapid internet survey assessment of food security and COVID-19 impact of 1500 households across North Carolina, as well as a survey during COVID testing focused on vulnerable and minority populations in focus counties engaging 174 respondents (Anson Cabarrus, and Rowan). In the geospatial mapping project, we mapped and compared food environment and food security variables in comparison with COVID-19 rates across the state. We conducted qualitative data collection with 13 food security organizations, primarily food banks in ACCORD target counties.

Goals and Tasks of Project

The specific aims of the project were: (SA1) Evaluate household food security as a factor in the social determinants of health in North Carolina during the COVID-19 crisis; (SA2) Assess the current supply conditions of food security in North Carolina in relation to household and community COVID-19 response; (SA3) Develop tools for enhanced food security during COVID-19 through interagency cooperation and program intervention to address the public health and economic impacts of COVID-19.

Outcomes

The project household surveys as part of SA1 conducted in fall 2020 revealed substantial levels of food insecurity across North Carolina. For example, the statewide internet panel survey of 1500 respondents found that 36% of respondents worried sometimes or often that their food would run out. Geospatial analysis for SA 2 of all North Carolina counties demonstrates relationships between a poor food environment and COVID-19 rates, suggesting the combined vulnerability of these communities. Further, in collecting qualitative data from food security organizations for SA3, many reported difficulty and strain meeting food aid needs during the COVID-19 pandemic. These data have been shared with the ACCORD/HOPE partners and in drafted manuscripts.

ACCORD Final Report

PI Name:

Dr. Darren R. Beneby, Dr. Jonathan W. Glenn

Project Title:

COVID-19 Impacts on Community-Based Interventions for Justice-Involved Minority Young Adults: Practitioner and Consumer Perspectives

Description of project.

This project aimed to capture the experiences of justice-involved young adults and practitioners in community-based interventions during the COVID-19 pandemic. While young adults were not accessible during the study time frame, two focus groups were conducted with practitioners working in local community-based programs serving this population. Four topic areas were assessed during focus groups: 1) COVID-19 impacts on practitioners and their working conditions, 2) The use of videoconferencing and other virtual services (telehealth information, on-line support groups, etc.) during the pandemic, 3) The effectiveness of the community-based intervention program with regards to program fidelity, intensity, sustainability, interagency collaboration, training, staff-buy-in, and assessment among other topics, and 4) How the double-crisis of the COVID-19 pandemic and incidents of police violence impacted their work with justice-involved, young adults of color.

Goals and Tasks of Project

The goals of our project were to conduct focus groups with fifteen practitioners and justice-involved young people of color at community-based projects. We then planned to conduct follow-up focus groups with these populations six months after the initial focus group sessions.

Outcomes

The desired outcomes of this project are to be able to provide recommendations for rehabilitative interventions made by community-based programs during and after the pandemic. These findings can be specifically used for recommending non-carceral alternatives for justice-involved offenders of color. Additionally, we are drafting to two manuscripts for publication. The first of the manuscripts will review practitioners' perceptions of their program's operations during the pandemic. The second manuscript will review practitioners' experiences counseling youth on the topic of police violence during the pandemic. Finally, the last outcome of this project will be to apply for additional funding to conduct research on interventions for young people of color during the pandemic. We have identified a current solicitation from the United States Department of Justice's National Institute of Justice to study interventions facilitating the administration of justice, and aim to leverage the present study in our application for funding.

Attachment F ACCORD Final Report

PI Name: Brittany Baker and Irene Doherty

Project Title: Acceptability and Barriers to COVID-19 Testing, Tracing, and Immunization Among African American Students and Residents in Low-Income Communities

Description of project.

This project was designed to assess COVID-19 vaccine acceptability and barriers to vaccination for African American students at an HBCU. The project utilized individual interviews to understand students' perceptions. Continuation of the project will involve the use of focus groups to collect data on student perceptions of contact tracing as well as more data on nursing students' perceptions when caring for clients in the community setting during the COVID-19 pandemic.

Goals and Tasks of Project

Goal #1: To investigate acceptability and barriers for COVID-19 vaccination among African American students at an HBCU (North Carolina Central University)

Tasks: Student interviews, interview transcription, data analysis, dissemination

Specific Aim #2: Assess and describe student nurses' experience in community health settings with patients' acceptability and barriers to COVID-19 related testing, tracing, vaccine uptake in low-income African American communities

Tasks: Accompany students to nursing clinical setting in low-income community, provide faculty oversight as they perform wellness checks, debrief with students to understand themes in care and resident perception.

Outcomes

Data analysis of student acceptability is still underway, but preliminary findings included a theme of mistrust related to the COVID-19 vaccine. It was also noted that vaccine perceptions appear to be influenced by familial preferences and health cultures. Additional data will be collected with the use of student focus groups over the next few months.

Student perceptions while in community health settings included perceptions of hesitancy and mistrust.

Field-Ready Genetic Coronavirus Test for Use in Low-Resource Underserved Populations

ACCORD Pilot Project, June - December 2020

The Julius L. Chambers Biomedical Biotechnology Research Institute, NCCU, Durham NC
PIs; John T. Moore and Deepak Kumar, Consultant: Fangping Zhao

Abstract: New technology breakthroughs are needed to improve COVID-19 surveillance capabilities, making them more accessible to all communities. Towards this aim, we have developed a SARS-CoV-2 field test, implementing novel methodologies to improve the ease of running the assay, while maintaining sensitivity compared to current laboratory tests. Our final assay is enabled by two significant technology advances: 1) A novel Lysis buffer, which eliminates the need for RNA isolation, and which does not interfere with downstream enzyme reactions. The omission of RNA extraction kits and related supplies cuts the costs associated with these supplies and simplifies the procedure. 2) An all-in-one Lyophilized amplification mix, which has all the reaction components for enzymatic steps and is pre-aliquoted in assay tubes and eliminates the need for multiple liquid transfers and associated errors. The all-in-one lyophilized reagent also avoids cross contamination of separated reagents. Additional features of the assay include: no trained professional required, low cost, appropriate sensitivity and specificity required for clinical testing, and quick turn-around time (30-60 min) to guarantee timely response. The availability of our streamlined field test can facilitate penetration of critical PCR based SARS-CoV-2 testing into underserved communities with high accuracy and quick turnaround.

Background

Due to increases in climate change, deforestation, and human population, viral pandemics are predicted to become more frequent (1). Key technological advances in testing are needed to limit the impact of pandemics on human mortality and global economies. Testing for active infection allows early identification of carriers, both symptomatic and asymptomatic, isolation of affected areas, thus limiting spread. From an individual health care perspective, testing allows differentiation of the pandemic disease from diseases with related symptoms to guide proper treatment regimens. Broad and efficient testing would also allow community activities to continue in a safer environment and avoid the negative consequences of job loss, risk of exposure to infected coworkers while on the job, reduced educational opportunities, and social isolation.

Most current testing technologies rely on sequence identification using nucleic acid isolation, thermal cycling, and detection of fluorescence markers using expensive advanced technologies. These types of tests are only available in areas where a developed and coordinated medical infrastructure is present. For example, at the time of this writing, an example of centralized production lab test (50,000 assays/day, with round-the-clock run time) costs approximately $20/assay plus consumables, plus labor, resulting in a $100 insurance charge. These approaches also require skilled technicians to run the assays.

Advances in testing to make it more accessible would benefit the current health disparities associated with the current COVID-19 pandemic. Demographics show that minority populations are bearing a disproportionate number of COVID19 cases and deaths, both in the U.S. and in other countries (3). This disparity represents a combination of medical and socioeconomic factors. Undoubtedly, health disparities will be associated with future pandemics, regardless of the underlying biological mechanisms, due to socioeconomic limitations such as access to healthcare, more crowded living conditions, lack of ability to work from home, and significantly, limited access to expensive testing.

As one response to the health disparity issues, we envision an efficient point-of-care assay that can be used in underserved communities to test for active carriers of coronavirus. We propose to establish a streamlined, inexpensive process for extracting nucleic acid that is of sufficient quality and quantity for immediate use in an isothermal PCR reaction. The foundation of this project is isolation of genetic-analysis-ready nucleic acid from a human sample (initially saliva) with minimal processing. The key components desired for initial mix are the nucleic acid extraction buffer and the specific primers and enzymes needed for PCR. In this proposal, we describe a path to develop a novel SARS-CoV-2 test which can be run at the point-of-care (e.g., rural developing nations, and underserved portions of the United States). The test would be nucleic acid-based and thus adaptable to other pathogens, such as pandemic flus (recent example, the H5N9 influenza strain recently detected in China).

Materials

Heat-inactivated SAR-CoV-2 virus (1000 virus/ul) was purchased from ZeptoMetrix. Nucleic acid fast extraction column was purchased from Biofactories (Korea) (http://www.bskbio.co.kr/bbs/view.php?id=Supplier&page=1&sn1=&divpage=1&sn=off&ss=on&sc=on&select_arrange=headnum&desc=asc&no=55&type=board&PHPSESSID=d54cd3639ac1026199a6ba8b028d3e33&ckattempt=1).SARS-CoV-2 real-time PCR primers (CDC validated sequences) and probes (targeting viral tN1 and N2 as well as the housekeeping gene RNaseP) were synthesized at IDT. Reverse Transcriptase was purchased from Thermo Fisher. Reverse transcription of RNA samples was carried out as per manufacturer's instructions with 1ul RTase used for every 20ul reaction. Oligo dT primers and Random primers were synthesized at Eton Biosciences. MIC-PCR machines were from Bio Molecular Systems, Australia.

For lyophilization of combined RT-PCR reagents, all components were pre-mixed (minus the sample volume) and combined with lyophilization additives (ZY therapeutics). Lyophilized reagents were stored at -20C, 4C, or room temperature until needed for testing.

Results

Sample collection: The use of saliva as a valid source for SARS-CoV-2 screening has been established in other studies (4) and we have chosen this method due to its convenience over the more invasive deep nasal swab sample collection procedure. A variety of commercially available 1-2ml plastic collection vials were tested. All collection vials were functionally valid and only varied in convenience to the user and potential for contamination down the sides of the collection vessels. We preferred the use of vials that had a widened disposable plastic spout over the lid (see **Figure 1**). Sample collection vials are labeled with fill lines to standardize collection volumes.

Figure 1: Saliva was used as sample source. Figure shows one of the devices used in saliva collection.

Sample Lysis: We optimized a process for preparing saliva specimens through a simple lysis/heating step, obviating the need for the multistep column-based RNA isolation procedures used by commercial kits. In our final optimized procedure, 50ul saliva was spiked with either buffer (control sample) or with increasing amounts of heat-inactivated SARS-CoV-2 virus stock. Original stock (1000 virus/ul) and was serially diluted in PBS. The samples were then mixed with 50ul lysis buffer (prepared as described previously (5) with modifications. The mixture was heated at 85C for 5 min before being centrifuged at maximal speed (11,000 rpm) for 1 min. 2ul of the supernatant was used for an RT-PCR reaction. Comparing our Sample Lysis procedure to the traditional column-based procedure demonstrated that our Sample Lysis procedure (**Figure 2**), we found that our streamlined procedure resulted showed no loss of sensitivity versus the traditional method, and in fact may increase the sensitivity of viral detection from saliva.

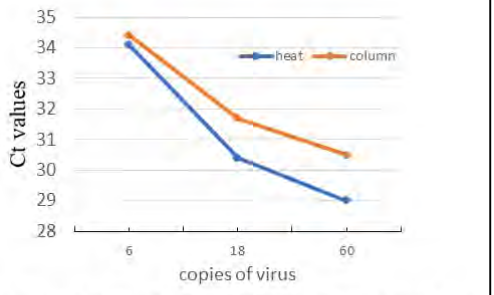


Figure 2: Comparison of the Sample Lysis procedure developed in our study (heat) versus the traditional methods (column). The Ct value, necessary to reach the sensitivity threshold (cutoff signal) is shown. The smaller the Ct value is, the more sensitive the reaction.

One-Step RT-PCR reaction: We tested a various reverse transcriptase sources for one step RT-PCR and identified one source of reverse transcriptase to be very compatible with our RT- PCR system. In addition, the duration of the reverse transcription (5-20 minutes) was optimized to ensure a sensitive and fast reaction. For One-Step RT-PCR, all reagents were mixed and the reaction was set up using the following cycling parameters: 1) 95C for 3 min, 2) 40 cycles of 95C for 5 sec, 3) 60C for 15 sec. The fluorescence signal on the SARS-CoV-2 virus-targeted primers was FAM and the fluorescence signal for the housekeeping gene

primers was HEX. To test the sensitivity of the assay, different amounts of virus were spiked into saliva samples and two SARS-CoV-2 PCR primer:probe sets were tested (**Figure 3**). The PCR reactions utilized MIC-PCR machines and the customized thermocycling conditions as determined in these studies. 2ul of supernatant was loaded from each 20ul reaction. Ct values reflect the cycles (time) to reach the cutoff signal in each experiment. These results show that the assay is 1) dose dependent: more viral loading takes less time to reach the cut-off value, and, 2) the assay is extremely sensitive. Using the N1 primer:probe set, we could detect as low as 2 virions per reaction (equivalent to 1virion/ul saliva). Similar results were obtained using N2 primer: probe set.

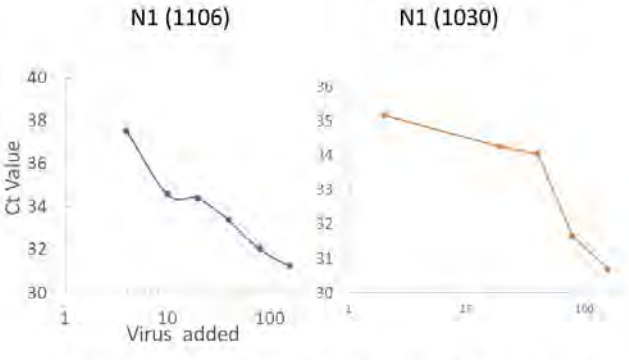


Figure 3: Assay sensitivity: The sensitivity of our optimized assay in detection of a range of heat-inactivated SARS-CoV-2 virus particles was tested using two primer sets, N1 (1106) and N1 (1030). The assay cutoff values (Ct) are plotted against virus input.

Lyophilization Optimization: To streamline our single-step procedure even further, we tested a variety of lyophilization conditions (various vessels and volumes) and lyophilization stabilization reagents (provided by ZY Therapeutics, RTP, NC) so that our assay components could be conveniently stored and transported without the need for cold storage, facilitating the use of the assay as a field test. Conditions were found where the RT-PCR mix could be lyophilized without losing viral detection sensitivity (viral detection efficiency) versus non-lyophilized control (**Figure 4**). Heat inactivated SARS-CoV-2 (200 virions) was added to the lyophilized RT-PCR reagents prior to the RT-PCR reaction. The experiment was repeated multiple times and shown is a representative result. This method allows a one tube procedure without repetitive pipetting steps, significantly reducing the cost for the consumables. These parameters represent the final optimized assay conditions. Further optimization regarding stability of the lyophilized reagents is ongoing.

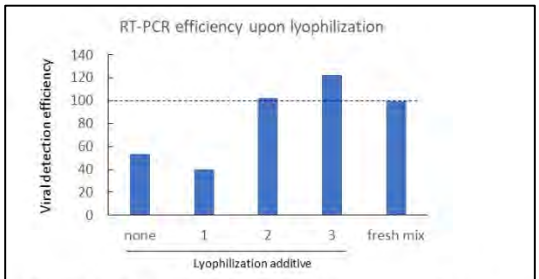


Figure 4: Optimization of lyophilization conditions: RT-PCR reagents were lyophilized in the presence of 3 different lyophilization additives and then tested for relative viral detection efficiency versus control (non-lyophilized "fresh mix").

Isothermal PCR tests versus RT-PCR tests: As a possible alternative to RT-PCR tests, we tested our lysed SARS-CoV-2 samples in isothermal PCR assays. Samples were processed as described by manufacturer and 25ul LAMP reactions were set up using a heat-inactivated SARS-CoV-2 virus range of 2-160 virus particles (**Figure 5**). In our hands, the isothermal PCR assay was not as sensitive using our lysed samples, and also produced a high rate of false positive samples (data not shown). Utility of lyophilized reagents in isothermal PCR reactions will be addressed in future studies.

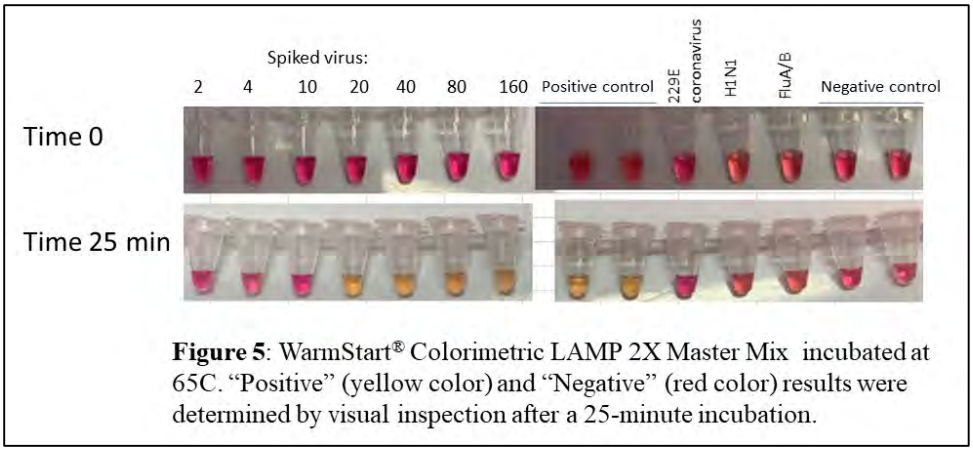


Figure 5: WarmStart® Colorimetric LAMP 2X Master Mix incubated at 65C. "Positive" (yellow color) and "Negative" (red color) results were determined by visual inspection after a 25-minute incubation.

Discussion

Our overarching goal was to develop a streamlined, field-ready genetic test for coronavirus in low-resource regions. Our final RT-PCR assay incorporates the desired properties for such a test. Our field-ready test can be performed with sensitivity and accuracy of a lab-based test, but with transportable reagents and equipment. Since the test eliminates the costly and time-intensive RNA-preparation step, minimizes the steps during PCR setup, it would be easy to implement and inexpensive, and so testing could be done multiple times during the course of a pandemic without hardship. Our final optimized assay involves, 1) Sample Collection: Isolation of the biological specimen (saliva) in lysis buffer, 2) Sample Preparation: Preparation of a nucleic acid-containing fraction by a simple heating and centrifugation step in one step, 3) Virus Detection: RT-PCR in a small desktop (micro-PCR) thermocycler using pre-loaded lyophilized assay reagents.

Using this assay, mobile testing sites could be sent into areas where testing is needed, and the simplicity of the test would allow quick training so that members of those communities could carry out their own testing. These tests would be a valuable resource for rural and/or socioeconomically distressed areas, in the United States as well as in International areas of need. The test was easily to be adapted for testing from low throughput to high throughput, another important component of addressing virus spread in communities. With one laptop and four micro-PCR machines, thousands of samples (and associated controls) could be processed in a single day using our assay. In addition, we are working with a local CLIA lab to test a high throughput version of this assay.

Most other new technology efforts in coronavirus testing are being performed by large companies that sell expensive equipment in parallel to support their assay and which are labor intensive despite the incorporation of the automation. To date, very limited at-home or field test devices are available. Thus, there are opportunities for point-of-care PCR assays with adjustable throughput. Efforts in this area by other companies have been reported, for example by Bosch Healthcare solutions, but our process is different from others that have been reported. The advantages/disadvantages for each coronavirus detection assay versus competitors can only be evaluated at a later stage of development.

Additional applications of the assay include community-wide monitoring of SARS-CoV-2, such as through testing of wastewater samples. Wastewater monitoring can quickly and efficiently assess the initiation of a local COVID-19 hot spot. The ability to monitor trends in a population through community-based monitoring is critical for better informing containment and prevention strategies, and especially important

when SARS-CoV-2 reinfections and episodic outbreaks begin to occur (6,7). Thus, our streamlined SARS-CoV-2 RT-PCR test would be adaptable to centralized lab testing as well as wastewater testing.

In summary, different coronavirus detection strategies and technologies described in our original proposal have been compared. We chose RT-PCR over isothermal amplification due to its reliability and sensitivity. The sample processing procedure for downstream PCR is critical for a field test because the final test components can be readily assembled into a portable kit for field work with a price point at pennies per assay. The convenience of operation, increased sensitivity, and adjustable throughput (low to high throughput) of our assay allows health workers to perform these assays without extensive training in a low setting environment for a more accurate diagnosis of the disease. Our eventual goal is to assemble low-cost all-in-one point-of-care devices for viral nucleic acid detection for convenient home/personal use.

In the future, if the need for coronavirus tests diminishes, the technology advances we make in these proposed studies can be quickly applied to another pathogen, in medicine or in agriculture. Since specificity is driven by primer/probe choice, the assay can easily be adapted to other infectious disease threats that are predicted to arise.

References

1. Wilson, M.L., Ecology and infectious disease, in Ecosystem Change and Public Health: A Global Perspective, J.L. Aron and J.A. Patz, Editors. 2001, Johns Hopkins University Press: Baltimore. p. 283-324.
2. Bryan A, Pepper G, Wener MH, et al. Performance Characteristics of the Abbott Architect SARS-CoV-2 IgG Assay and Seroprevalence in Boise, Idaho [published online ahead of print, 2020 May 7]. J Clin Microbiol. 2020;JCM.00941-20. doi:10.1128/JCM.00941-20
3. Krouse HJ. COVID-19 and the Widening Gap in Health Inequity [published online ahead of print, 2020 May 5]. Otolaryngol Head Neck Surg. 2020;194599820926463. doi:10.1177/0194599820926463
4. Teo AKJ, Choudhury Y, Tan IB, Cher CY, Chew SH, Wan ZY, Cheng LTE, Oon LLE, Tan MH, Chan KS, Hsu LY. Saliva is more sensitive than nasopharyngeal or nasal swabs for diagnosis of asymptomatic and mild COVID-19 infection. Sci Rep. 2021 Feb 4;11(1):3134. doi: 10.1038/s41598-021-82787-z. PMID: 33542443; PMCID: PMC7862309.
5. Ishii, S., Loynachan, T.E. Rapid and reliable DNA extraction techniques from trypan-blue-stained mycorrhizal roots: comparison of two methods. *Mycorrhiza* **14,** 271–275 (2004). https://doi.org/10.1007/s00572-004-0316-3.
6. Choi PM, Tscharke B, Samanipour S, et al. Social, demographic, and economic correlates of food and chemical consumption measured by wastewater-based epidemiology. *Proc Natl Acad Sci U S A*. 2019;116(43):21864-21873. doi:10.1073/pnas.1910242116
7. Daughton CG. Wastewater surveillance for population-wide Covid-19: The present and future. *Sci Total Environ*. 2020;736:139631. doi:10.1016/j.scitotenv.2020.139631

Attachment F ACCORD Final Report

PI Name

Nathan Wymer, PhD - Department of Chemistry and Biochemistry)
Lindsey M. Costantini, PhD - Deparment of Biological and Biomedical Sciences)
Vijay Sivaraman, PhD - Deparment of Biological and Biomedical Sciences)

Project Title

Development of a Conjugate Vaccine Against SARS-CoV-2

Description of Project

While several vaccines against SARS-CoV-2 have been authorized by the FDA, many different types of vaccines are needed in order to combat this evolving threat. Conjugate vaccines have been generally overlooked by pharmaceutical companies to combat the coronavirus pandemic. This oversight is likely due to the history of conjugate vaccines only being used previously for bacterial infections but not viral pathogens. For example, CRM197 carrier protein have been successfully developed to prevent several microbial infections, e.g., pneumococcal and meningococcal infections. Conjugate vaccines can be more difficult to develop than the current mRNA-based vaccines, but conjugate vaccines may provide longer lasting protection as well as may be better at protecting infants and the elderly. The overall goal of this project is to create initial conjugate vaccine candidates against a model coronavirus to determine if the conjugate vaccines can be a viable option against viral outbreaks.

Goals and Tasks of Project

1.) **Production of anti-SARS-CoV-2 antibodies in rabbits:** Polyclonal antibodies were prepared to determine if CRM197-based vaccine candidates can behave as an adjuvant to generate an immune response with protein and peptide antigens. Proteins and peptides do not generally illicit an immune response without the addition of adjuvants. These vaccine candidates would create an immune response against the SARS-CoV-2 spike protein receptor binding domain (S-RBD) and the external portion of the SARS-CoV-2 membrane (M) protein. The purified S-RBD was purchased, and the M-peptide was custom synthesized. The S-RBD and M-peptide were conjugated onto the CRM197 carrier protein in order to create two vaccine candidates. These two candidates along with unconjugated S-RBD and M-peptide control samples were shipped to Eton Biosciences in order to create polyclonal antibodies in rabbits. The unconjugated samples were mixed with their adjuvant in order to create a baseline immune response.

2.) **Developing vaccine candidates against a model coronavirus:** The CRM197 carrier protein and mouse coronavirus Mouse Hepatitis Virus (MHV-A59) spike protein receptor-binding domain (S-RBD) were recombinantly expressed in *E. coli* and HEK293 mammalian cells, respectively. The N-terminus of the envelope (E) and membrane (M) proteins of the MHV-A59 viral particle are located externally and may serve as a secondary target for the immune system. The external peptide portions of the E and M proteins were custom synthesized. These peptides included a C-terminal cysteine amino acid in order to facilitate conjugation.

The S-RBD protein, E-peptide, and M-peptide were each conjugated to CRM197 carrier proteins in order to create three vaccine candidates. Mice were inoculated and a booster with these vaccine candidates. The mice were given time to develop an immune response before being infected with live MHV-A59. The health of the mice would then be monitored.

Primary sequences:
SARS-CoV-2 Spike Receptor-Binding Domain (S-RBD) + C-6xHis:
RVQPTESIVRFPNITNLCPFGEVFNATRFASVYAWNRKRISNCVADYSVLYNSASFSTFK
CYGVSPTKLNDLCFTNVYADSFVIRGDEVRQIAPGQTGKIADYNYKLPDDFTGCVIAWN
SNNLDSKVGGNYNYLYRLFRKSNLKPFERDISTEIYQAGSTPCNGVEGFNCYFPLQSYGF
QPTNGVGYQPYRVVVLSFELLHAPATVCGPKKSTNLVKNKCVNFHHHHHH

SARS-CoV-2 External Envelope (E) Peptide:
MYSFVSEETGTLIVNSC

SARS-CoV-2 External Membrane (M) Peptide:
ADSNGTITVEELKKLLEQWNLVIGC

MHV-A59 Spike Receptor-Binding Domain (S-RBD) + C-6xHis:
MGILPSPGMPALLSLVSLLSVLLMGCVANLPACNIEEWLTARSVPSPLNWERKTFQNCN
FNLSSLLRYVQAESLFCNNIDASKVYGRCFGSISVDKFAVPRSRQVDLQLGNSGFLQTAN
YKIDTAATSCQLHYTLPKNNVTINNHNPSSWNRRYGFNDAGVFGKNQHDVVYAQQCF
TVRSSYCPCAQPDIVSPCTTQTKPKSAFVNVGDHCEGLGVLEDNCGNADPHKGCICANN
SFIGHHHHHH

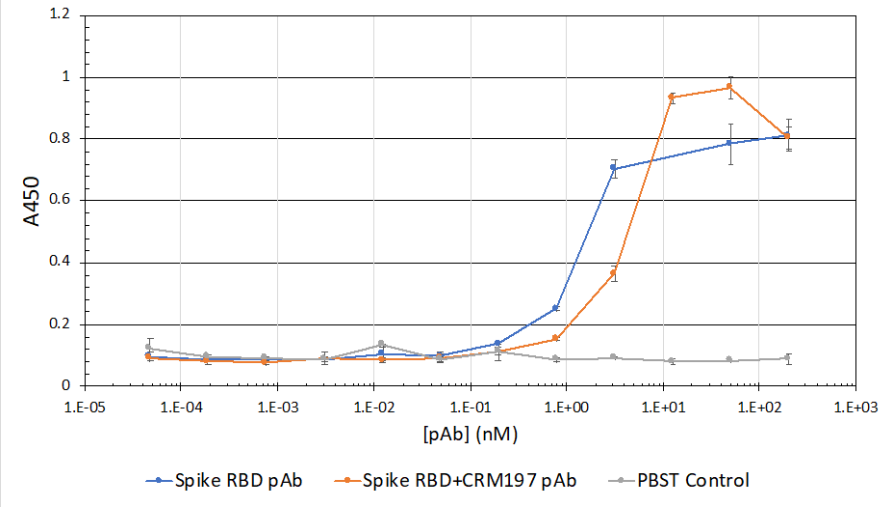
MHV-A59 External Envelope (E) Peptide:
MFNLFLTDTVWYVGQIC

MHV-A59 External Membrane (M) Peptide:
SSTTQAPEPVYQWTADEAVQFLKEC

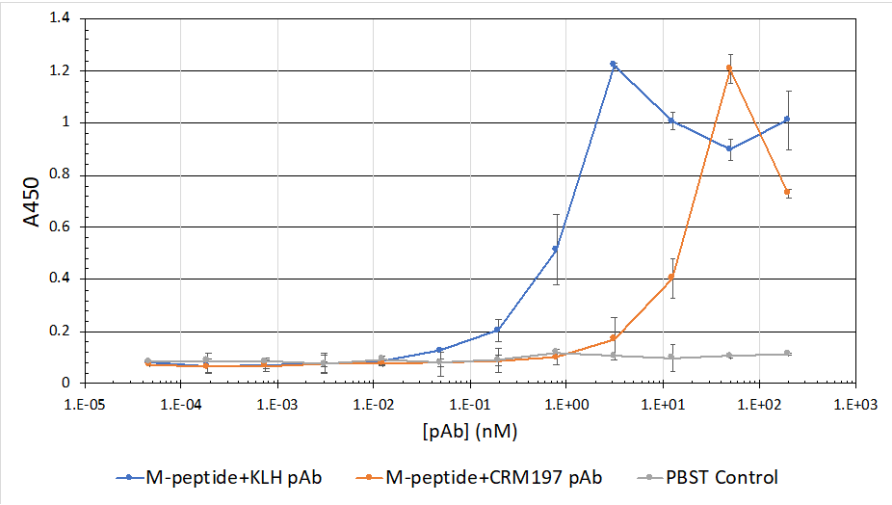
Outcomes

1.) **Production of anti-SARS-CoV-2 antibodies in rabbits:**

The purified rabbit polyclonal antibodies (pAbs) against the SARS-CoV-2 S-RBD and M-peptide arrived approximately two months. The antibodies were tested with an enzyme-linked immunosorbent assay (ELISA). The anti-S-RBD pAbs were tested in a microplate with purified S-RBD captured upon the bottom of a microplate well. The purified S-RBD contained a C-terminal 6xHis purification tag. An anti-6xHis antibody was attached to the bottom of the microplate well and used to capture the S-RBD protein. The anti-S-RBD pAb samples were then mixed at various dilutions to determine a binding curve and dissociation constant (Kd). The unconjugated and CRM197-conjugate S-RBD samples appeared to have Kd values of approximately 5 nM and 20 nM, respectively.



The anti-M-peptide pAb samples were also tested with an ELISA in order to determine their Kd values. A microplate well that had been modified to contain maleimide functional groups were used to bind M-peptide. The anti-M-peptide pAb samples were then tested at various concentrations in order to calculate their Kd values. The unconjugated M-peptide sample was conjugated to the keyhole limpet haemocyanin (KLH) adjuvant before injection into rabbits. The Kd values for the KLH-M-peptide and CRM197-M-peptide pAb samples were determined to be 1 nM and 20 nM, respectively.



For both sets of pAb samples, the non-CRM197 pAb provided a better Kd value. This result is likely due to the unoptimized state of the initial CRM197-based pAb samples. The goal of this project was to provide a proof-of-concept result that demonstrated whether CRM197-based antigens could create strong-binding antibodies. This result is especially encouraging for M-peptide since the peptide is small (25-mer).

2.) **Developing vaccine candidates against a model coronavirus:**

The vaccine candidates and controls were formulated and 2.5 µg of the candidate or control was injected into each balb/c mouse. Five cohorts of ten mice each were used for each arm of the

study. The mice were then given a 2.5 µg booster injection or control. The mice were then infected with an intranasal introduction of MHV-A59 viral particles seventeen days after the booster. An LD50 concentration of MHV-A59 was used for infection. The mice are then observed for mortality and morbidity, including measuring changes in lung function using spirometry. The initial cohorts of mice have only recently been infected with MHV-A59 so the no initial results are presently available. The results of this initial study will inform in the design of vaccine candidates and protocols for future mouse studies.

Mouse study cohort arms:

1.) CRM197-Spike RBD conjugate vaccine candidate
2.) CRM197-Envelope external peptide conjugate vaccine candidate
3.) CRM197-Membrane external peptide conjugate vaccine candidate
4.) CRM197-only control
5.) Resting mice

Attachment F ACCORD Final Report

PI Name Danai Fannin

Project Title *Experiences of African American Caregivers of Children with Autism: Rurality and Resources During the COVID-19 Pandemic*

Description of project As we are in the midst of the pandemic, the impacts of social distancing have been largely anecdotal, thereby requiring methodical, scientific documentation of caregivers' experiences to make informed decisions on how to serve families of children with autism spectrum disorders (ASD). Some caregivers of children with ASD have reported significantly higher amounts of emotional and economic stress than caregivers of children with other developmental disabilities. It is no longer enough to gather only quantitative data if one is to conduct thorough, robust analyses of caregiver perspectives, and this has been borne out in a documented increase in qualitative studies of racial/ethnic minority caregivers of people with ASD. Studies have shown caregivers to cite personal challenges and their own emotional distress as barriers to effective caregiving and some AA caregivers experience the added cultural stressor of racial discrimination.

Although it is acknowledged that caregiving of people with ASD has its challenges, this data comes from primarily homogeneous (European American, middle SES, urban) study samples, so the full experience of caregiving across cultures is still in question. So as not to presume that AA caregivers are necessarily having negative experiences, the Co-Care KIT is an Experience Sampling Method tool from the field of positive psychology, designed to capture the range of experiences. By analyzing variables within racial/ethnic and across geographical and SES groups, service providers can be more responsive to what families may or may not need in their communities, and better develop targeted implementation strategies to promote health equity during the current and future pandemics that require social distancing. The purpose of this study is to therefore examine the experiences of AA families dealing with educational and health disparities within this unique context of COVID-19 using the following aims:

> Aim 1. Describe whether AA caregivers of children with ASD differ by geography and SES on reported family needs, sources of support, stress, and contextual factors they consider important to ASD services in their community during the time of social distancing as a result of COVID-19.
>
> Aim 2. Describe the personal and varying daily experiences of rural and urban, low and middle SES, AA caregivers of children with ASD during social distancing as a result of COVID-19.

Goals and Tasks of Project

Participants will be purposefully sampled including AA caregivers of children diagnosed with ASD who live in rural Halifax County (*n=15*) and urban Durham County (*n=15*) and are from both low and middle SES homes (as indicated by a pre-screening questionnaire). Participants will complete 15 surveys via the internet to gather data about the contexts wherein the families exist, and how those factors impact access to and quality of services. Individual interviews will

be video and audio-recorded through the web platform (e.g., Zoom or WebEx), transcribed verbatim, and cross-checked for accuracy. Data will be inductively analyzed via content analysis using NVivo software (Elo & Kyngas, 2008). Quantitative and qualitative results will be triangulated for interpretation (O'Cathain et al., 2010). This involves a) collecting qualitative and quantitative data; b) distinguishing salient results; c) examining confidence in the results and; d) developing criteria for inclusion of results for interpretation. To wit, the Co-Care KIT has not yet been applied to caregivers of children with ASD. The Co-Care-KIT includes:

- a journal for writing and reflecting about daily experiences with predesigned pages for supporting experience disclosure, and writing tools like pens, markers, and Post-it notes
- a small, digital camera with an instant photo printer to visually capture experiences with photos.
- a waterproof activity wristband to continuous sly measure heart rate variability (HRV) as a stress indicator and the wearers' sleep stages overnight. Many children with ASD have sleep disturbances and insomnia, so sleep patterns of the caregivers might be of interest. Heart-rate graphs will be printed and displayed along with participants' photos and journal quotes for a visual interpretation of how participants felt at the time the photo was taken.

1. Potential participants are screened via an online questionnaire and, if they qualify, will complete an online consent form. The initial interview will also be scheduled via phone.
2. Participants will then proceed with completion of the surveys of which they will be notified via a SonaSystems website platform. The website emails participants when surveys are ready for them to complete, and presents the Qualtrics surveys that have been interfaced with the SonaSystems platform. The participant simply clicks on a link in the email, logs onto the website, and proceeds with the surveys.
3. Once surveys are completed, the researchers will have a ZOOM interview with the caregiver for approximately 45 minutes where use of the camera, heart rate monitor, and web-based surveys will be described via a Zoom or WebEx meeting. The 2-week Co-Care KIT collection will begin on a day agreed upon with the PI. The entire Co-Care KIT will be left on the participants' doorsteps to avoid physical contact.
4. The Co-Care KITs will be collected from the participants' doorsteps at the end of the 2 week journaling for the PI to download the heartrate readings onto the lab computer. Each caregiver will be debriefed with a closing interview (lasting approximately 90 minutes) where data will be discussed and evaluated by the participant and PI. Biofeedback in the form of heartrate measurements can be used as a physiological indicator of mental effort and emotions like worry or stress, and be a measure of psychological health and stress. These measurements will not be used for medical purposes. Rather, it is a visual representation of psychological states to complement the pictures and journal entries. Heart rate measurements of each caregiver will be plotted by the PI on daily timelines with the printed photos, providing an overview and context for the recorded moments such as time, location, and people. These data will be discussed with each caregiver, using the data conversation prompts. For example, photos and heart rate measurements will be shared and discussed and interpreted by the caregivers while the PI questions them about it.
5. All interviews will be transcribed and coded by two research assistants (RA). Transcriptions will be analyzed using applied thematic analysis, a broad inductive method in which key themes are identified in text and transformed into codes. Applied thematic analysis assumes a

researcher's effect on the data because journal entries, photos, heartrate readings will be reviewed to formulate additional questions for the final debriefing interview. The PI will then train another set of blinded undergraduate RAs to verify the transcripts and code them.

Outcomes

All supplies were ordered and surveys set up in Qualtrics and interfaced with SonaSystems participant site for data collection. Recruitment started increasing after the holiday and we have started data collection with 12 participants. The PI also received participant incentive gift cards (from separate BBRI funds) for when they have completed the first phase of data collection. Once all of the backordered supplies have arrived from CDW-B, the journaling section of the study will start.

Attachment F ACCORD Final Report

PI Name

Kayvan Miri Lavassani

Project Title

Global Supply Chain of Medical Equipment: Vulnerability Assessment, Emergency Response Tool, and Financial Impact Analysis

Description of project.

In this project we could successfully develop and analyze the global supply chain network map of medical equipment across five tiers of supply chain and four levels of network types.

We mined complex supply chain data using a unique method from financial reports of millions of firms from across the world. After developing and visualizing the global supply chain map of medical equipment, we analyzed the data using three methods as outlined in the following.

a. Attacks to the Global Supply Chain

We simulated several intelligent & random attacks to the global supply chain of medical equipment to identify the vulnerabilities of the supply of medical equipment. These attack methods have notable applications in the study of national security, pandemics, public health, and global economic rivalries.

b. Network Visualization & Analysis

We conducted several analyses to identify the underlying pattern of the global supply chain of medical equipment. We produced numerous visualizations to explore the supply chain from different perspectives. This analysis uncovered several previously unknown patterns of the supply chain. We also developed scenarios that replicate how the global supply chain can be affected when disruption occurs in a firm, industry, or country.

c. Regression Analysis

We used regression analysis to measure the effect of the firm's supply chain properties, on their financial performance. We also analyzed a major simulated disruption scenario (i.e., eliminating China from the global supply chain of medical equipment) to study how such disruption affects other firms' financial performance.

Goals and Tasks of Project

Our goal was to identify the underlying pattern of the global supply chain of medical equipment, conduct vulnerability assessments, simulate disruption scenarios, and measure the effect of interruptions on firms' financial performance.

Outcomes

Some of the highlights of our findings are described here based on the three research projects we conducted using three different methods.

a. Findings from Attacks to the Global Supply Chain

We find that the medical equipment supply chain is vulnerable to both random and targeted disruptions. For example, random disruption of 10% of firms causes medical equipment suppliers to be able to reach only 60% of their end suppliers, with 20% of medical equipment suppliers unable to reach any end suppliers. For targeted attacks or random failures correlated with firm size, the situation is much worse: with 10% firm disruption, medical equipment suppliers can only reach 20% of their end suppliers on average.

We also consider more specific scenarios. For example, if US-China trade relationships broke down, China's medical equipment suppliers could reach on average 57% of their end suppliers, while the U.S. medical equipment suppliers notably less. As another example, we find that disruption of the "Auto parts and equipment" sector could make 10% of the end suppliers unreachable. While perhaps counterintuitive, this result accords with the U.S. government's decision to ask auto manufacturers to produce ventilators earlier in the pandemic.

b. Findings from Network Visualization & Analysis

Several previously unknown patterns of the supply chain were discovered using visualization and network analysis. Our clustering analysis revealed the unexpectedly high influential role of Malta and Gibraltar territories in the global supply chain of medical equipment. These two territories are generally used as headquarters of shell corporations for tax planning purposes. In our mined data, we identified corporations registered in Brazil, Canada, Germany, Guernsey, Indonesia, Italy, Kenya, Mexico, Sweden, United Kingdom, and the United States having transactions with these two territories. It is important to note that Malta and Gibraltar are not the only territories that we identified to be used for tax evasion; however, the transactions in these two territories were so dispersed across different countries and had such unique characteristics that led our algorithm to identify them as their own community. In fact, the deeper analysis revealed that Gibraltar has higher global "bridging centrality" than several advanced countries, including the United States. The high bridging centrality indicates that these two territories are extensively utilized as bridges between the other larger clusters of firms to facilitate tax evasion.

Another interesting finding was with regards to the key sectors related to medical equipment. Globally we identified three (3) major sectors influencing the global supply chain of medical equipment, namely: "Auto parts and equipment", "Computer programming & software", and "semiconductors". We identified China to be in notable control of the global supply chain of

medical equipment through its "Motor vehicle & car body" sector in “mainland China”, as well as its “Semiconductor” sector in “Taiwan”. The United States’ mote notable influence in the global supply chain is through its “computer programming and software” sectors.

c. Findings from the Regression Analysis

We identified how the firms' location across the complex network of the global supply chain of medical equipment could affect its financial performance. Here some of the findings that can be presented without extensive reference to the technical analysis are presented.

In our analysis, we found that firms with more suppliers and fewer customers have better financial performance. This could be a characteristic of a manufacturer of final (or closer to final) product where several original part manufacturers are supplying the parts to be assembled into a product that will be supplied to a small number of distributors and wholesalers, potentially with an added value of the brand (versus parts which mostly have the characteristics of a commodity). We hypothesized that firms positioned on longer connected supply chains would have higher financial performance. However, the result suggested otherwise. More vertically integrated firms in the medical equipment sector were found to capture greater value in their operation and hence have higher levels of financial performance. Also, firms operating in larger clusters (ecosystems) of firms are found to have lower financial performance.

We also conducted a simulation analysis by eliminating China from the global supply chain and measure the effect of the relationship between network properties and firms’ performance. In the simulation, while the number of suppliers exhibited a positive effect on the firms’ performance, the number of firms’ customers was not significantly influenced by the firms’ performance. Eigenvector only showed a positive impact on ROA. PageRank centrality was found to have a significant negative impact on the firms’ performance. The analysis of PageRank indicates that firms with a higher degree of deep dependencies to the global supply chain will have a worse financial performance when China is removed from the global supply chain. The next notable finding in the simulation was concerning the clustering coefficient. We hypothesized that if a firm is part of a highly connected group of firms it is expected to have better performance as it creates more stability. However, as China plays an important role in the global supply chain its elimination had such a magnitude that its elimination results in a negative relationship between the clustering coefficient and q ratio.

Application for Policy Makers

Using our three inter-connected projects outline previously, we discovered previously unknown supply chain patterns and relationships that have vital effect on the United States' national security, the public health of Americans, and the nation's economic prosperity. We believe the policymakers should incorporate the underlying (often hidden) patterns of the supply chain in their regional, and national strategies. Some of the recommendations are presented in the following.

The medical equipment supply chain is dependent on three main sectors: Auto, Software, & Semiconductors. Protecting these three industries is crucial to secure medical equipment supply. A point

of concern for us in analyzing the global supply chain is dependencies on the Chinese auto sector, including the Chinese part suppliers (in mainland China), and dependencies on semiconductor manufacturers in Taiwan. In addition to the dangerously high reliance of the U.S. to Taiwanese semi-conductor manufacturers at the moment, we anticipate a new thread arise affecting the supply chain of medical equipment stemming from electrification of the automobiles in the upcoming decades. With elimination of the high demand for internal combustion engine, several U.S. part manufactures which are currently part suppliers to the medical equipment manufacturers will disappear.

Regarding random and intelligent attacks analysis that we conducted, we have developed the list of firms and industries whose elimination will create the most disruption to the global supply chain of medical equipment. The COVID-19 pandemic is an example of a random attack, which randomly affected operations around the world. We have also developed mathematical models that simulate the effect of intelligent attacks (e.g., terrorist attacks, wars, trade bans/disputes, etc.) on the supply of medical equipment. The policymakers should consider strategies to protest the key firms and the key industries whose elimination can create the most disruption in the supply chain of medical equipment.

Finally, the third implication is related to firm’s financial performance. As firms' performance is connected to our citizens and our nation’s prosperity, our findings can guide policymakers to identify and protect the firms and sectors through their well-informed policies.

While we conducted this study on the global supply chain of medical equipment, we can collect and analyze supply chain data for any industry worldwide.