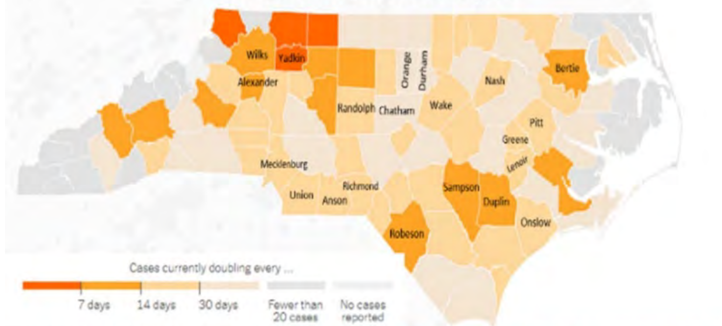
Lead PI: *Radiah C. Minor*, Associate Professor, Animal Sciences **Co-PIs**: *L. Williams*, Director, CEPHT, CAES, *A. Gentry-Apple* DVM, Animal Sciences, *U. Anele*, Assistant Professor, Animal Sciences, *Y. Fasina*, Assistant Professor, Animal Sciences, *J. Waterman*, Associate Professor Biology, and *V. Kelkar*, Adjunct Professor, Biology

The 2019 novel Coronavirus, SARS-CoV2 is responsible for the current global pandemic. Nationally, there have been over 1.5 million confirmed SARS-CoV2 infections and nearly 90,000 deaths[1]. According to the NCDHHS COVID-19 dashboard (as of 05/17/2020), NC has over 18,512 confirmed cases, 493 hospitalizations and 659 deaths[2]. Testing, social distancing and stay-at-home orders have helped to slow viral spread particularly in the most highly populated counties (e.g. Mecklenburg, Wake, Durham, and Orange). For example, on 5/17 there were 1,212 cases reported in Wake county but the doubling rate of 30 days for new cases (Figure1)[1]. In contrast, many less populated "hotspot" counties (Duplin, Sampson, Bertie, Alexander, and Robeson) have an average new-case doubling rate of 11.1 ± 1.8 days (Figure1). Others (Anson, Bladen, Richmond, Randolph, Pitt, Greene, Lenoir, Nash, Onslow, and Union) are doubling at an average rate of 18.5 ± 3.17 days (Figure1)[1].

FIGURE 1: NC COVID-19 Hot Spots



Source: NY Times interactive coronavirus cases. https://www.nytimes.com/interactive/2020/us/north-carolina-coronavirus-cases.html. As of May 17, 2020

These "hotspot" NC counties are significantly involved in food animal (pig, poultry, and cattle) production, and although COVID-19 infections in food animals have not been reported, there is anecdotal and scientific evidence supporting our hypothesis that food animals may harbor the SARS-CoV2. First, SARS-CoV2 is suspected to have originated from wildlife [3] and animals, including a tiger and two dogs, (one in Hong Kong, another in Chapel Hill, NC) have tested positive. The commonality in these cases is that these animals were in proximity to people that tested positive for COVID-19. Second, SARS-CoV2 was reported to infect cell that expressed the angiotensin converting-enzyme II receptor of animal (bats, civets, and swine) origin [3] (studies on poultry or cattle have not been done). Finally, two related coronaviruses (MERS-CoV and SARS-CoV), have been detected in pigs [4, 5]. Thus, given their proximity with humans, food animals should be included in the NC SARS-CoV2 community testing initiatives. This is particularly important as NC considers approaches to mitigate the spread of COVID-19, and works to implement policies that ensure public safety, secure the food supply, and support the NC economy.

The objective of this innovative project titled "**Food Animal SARS-CoV2 Testing"** is to perform SARS-CoV2 testing on food animals across NC, including hotspot counties. Briefly, biological samples (nasal and blood) will be collected from swine, poultry, cattle and tested for the presence of SARS-CoV2 and SARS-CoV2-specific antibodies using CDC guidelines and protocols. If food animals are found to carry the virus, we will develop animal-specific standard operating procedures (SOPs) for sampling, testing and herd management practices aimed at mitigating the spread of the virus. NCAT is well positioned to lead and complete this project. NCAT is a CDC select agent laboratory and the multi-disciplinary personnel (an immunologist, microbiologist, respiratory biologist, animal scientists, board certified veterinarian and epidemiologist) have the requisite background and skills. Facilities and most major equipment needed are in place. Successful completion of this project will provide food animal testing data, animal-specific tests, SOPs for sampling and post-COVID-19 husbandry practices, which collectively will inform policies and decisions for maintenance of a safe food supply and public health. The timeline, deliverables (Table 1) and high-level budget (Table 2) are presented.

TABLE 1 Project Timeline of Activities and Completion of Deliverables

June-October 2020	November 2020	December 2020
Activity: SOP development, Sample collection, testing, data analysis	**Activity:** Complete statistical analysis. **Deliverable:** Data on COVID-19 infection status amongst food animals.	**Activity:** Complete Grant Report. **Deliverable**: Sampling and testing protocols, husbandry SOPs and results.

TABLE 2 Project Budget

Salaries	Supplies & Travel	Total Request
$88,420.00	$159,500.00	$ 247,920.00

1. https://www.nytimes.com/interactive/2020/us/north-carolina-coronavirus-cases.html)
2. https://covid19.ncdhhs.gov/dashboard
3. Zhou, P., et al. Nature **579,** 270–273 (2020). doi.org/10.1038/s41586-020-2012-7
4. Vergara-Alert J, et al. Emerg Infect Dis. 2017 Feb;23(2):232-240. doi: 10.3201/eid2302.161239
5. Tanja Opriessnig, et al. Xenotransplantation. 28 March 2020 doi.org/10.1111/xen.12591

COVID-19 Research Proposals: AFFORDABLE IR FEVER DETECTION SYSTEMS for K-12, and Higher Education Facilities. PI: Dr. Raymond C. Tesiero, Co-PI: Dr. Balakrishna Gokaraju, Co-PI: Dr. Marwan Bikdash, and Co-PI: Dr. Greg Monty all from North Carolina A&T State University.

Statement of Work

This proposal is to integrate multi-disciplinary research that focuses on the innovation to rapidly develop affordable infrared (IR) fever detection systems that could be purchased by K-12, and higher education, and other facilities/consumers that are on a low or fixed budget. The current FEVER detection systems range between $10,000-$20,000. This proposal addresses fundamental research focusing on ***activities related to monitoring, assessing, and addressing the public health and economic impacts of COVID-19***.

The main goal of this research is to evaluate, design, develop and build **3 new *affordable* (within a price range of $1000-$2000) prototype IR fever detection systems:** (1) packaged system that will be wired to an existing computer station (front desk/administrator), (2) mobile station, and (3) retrofit system that would merge with an existing K-12 electronic system, to release front door or residential home alarm monitoring systems. These health safety systems could capture the thermal profile or elevated temperature information of human face, from a front door IR camera sensor to an administrator's desk or existing alarm monitor panel. The image processing algorithms will detect the inner body fever by focusing on elevated temperature around the inner canthus of the eye (fig.1).

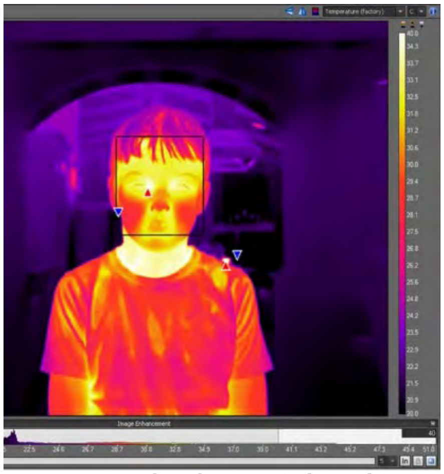


Figure 1 - Note the White Spot (red triangle) in the inner canthus of the eye.

System 1: this system would be a fixed mounted indoor packaged system that would be wired to the administrator's front desk existing computer station in departments, colleges, and universities or K-12 main offices. We would use the existing computer and supply the IR camera, mounting, wiring, conduit, and image processing software for under $1,000 per system. *System 2*: this system would be a complete packaged mobile station, it would incorporate a mobile cart stand for a monitor, with a mounted IR camera, and fever detection system. *System 3*: this system would involve retrofitting existing front door security stations with IR Fever Detection capabilities (existing video doorbell, or audio doorbell, and front door security release systems). We will evaluate our fever detection systems and compare the results with the current expensive IR fever detection systems.

Timeline & Deliverables

This research will be completed by December 30, 2020. Monthly Deliverables: June: Purchasing Equipment/Receiving/Planning/Design and Development, July: Build Prototype for System 1, August: Data Collection System 1 and Build Prototype for System 2, September: Data Collection for System 1 & 2 and Build Prototype for System 3, October: Data Collection for Systems 2 & 3 and Finalize System 1, November: Data Collection for System 3 and Finalize System 2, December: Finalize System 3 and write Final Report and Recommendations and begin research publications.

High-Level Budget

The breakdown and justification for each of the proposed components are provided. Fringe benefits are calculated at a rate of 36% on the salaries and wages of Senior/Key Personnel. 1.5 month summer salaries for PI and 3 Co-PIs $67,000 x 36% Fringe = $92,000. 1.5 month summer salaries for 3 Graduate Students x 1.5 months x $20/hr x 40 hrs/week x 4 weeks/mo = $14,400 x 7.65% Fringe = $15,501. 1 semester salary (August-December 2020) for 3 Graduate Students x 5 months x $20/hr x 20 hrs/week x 4 weeks/mo = $24,000 x 7.65% Fringe = $25,836. Tuition 1 semester for 3 Graduate Students = $11,600 x 3 = $34,800. System 1: equipment expenses $35,000. System 2: equipment expenses $40,000. System 3: equipment expenses $50,000. Miscellaneous research supplies cost = $5,000.

Total Direct Costs **(Total Budget Request) = $298,137**

PI: Stephanie Teixeira-Poit, PhD, MS; Assistant Professor of Sociology; College of Health and Human Sciences
Co-PI: Vannessa Gharbi, MSW, LCSW, IBCLC, CCM; JPSW Student; College of Health and Human Sciences

Project Title. Predictors of and Strategies to Mitigate COVID-19 Cases and Death Among Older Adults in Nursing Homes and Residential Care Facilities

Background. Older adults in congregate living facilities have higher rates of death from COVID-19 than the general population. In North Carolina, 18% of COVID-19 cases and 61% of COVID-19 deaths were in long-term care facilities; nationally, there is wide variability in state guidelines regarding visitation, screening staff, and PPE use in these facilities (Chidambaram, 2020). Our project examines which pre-COVID-19 quality of care measures predict COVID-19 cases and deaths in congregate living facilities. We also examine community-level factors that perpetuated or mitigated disparities in the number of COVID-19 cases and deaths among older adults in congregate living facilities. Community-level risk factors are important because care providers reside in the community and are carriers bringing COVID-19 into congregate living facilities. Our *research questions include*: What facility-level and community-level factors predict the number of COVID-19 cases and deaths in congregate living facilities? What are actionable strategies that can be implemented to mitigate COVID-19 cases and deaths in congregate living facilities?

Data Source Compilation. We will compile data from four types of existing secondary sources: (1) NC Department of Health and Human Services' (NC DHHS) COVID-19 Ongoing Outbreaks in Congregate Living Settings Report provides data on the number of COVID-19 cases and deaths by staff vs. residents at each congregate living facility. Similar reports are available in other states. (2) The U.S. Centers for Medicare and Medicaid Services' Post-Acute Care and Hospice Provider Utilization and Payment Public Use Files ("PAC PUF") provides 2017 data on demographic and clinical characteristics, service utilization, and health outcomes of Medicare beneficiaries served in congregate living facilities. The PAC PUF also provides an identifier and zip code for the facility that will be used to compile existing community-level data from two other sources. (3) The U.S. Agency on Healthcare Research and Quality's Area Health Resources File ("AHRF") provides county-level data on health facilities and community characteristics that can help understand community context (e.g., rurality; healthcare shortage area). (4) County-level COVID-19 data (e.g., number of deaths; adherence to social distancing) will be compiled from public sources, such as NC DHHS. Our analysis will begin by focusing on North Carolina and South Carolina data, which are readily available now; analyses will expand to other states as additional data are released.

Data Analysis. We will conduct bivariate and multivariate analyses to examine facility-level and community-level factors that predict the number of COVID-19 cases and deaths in congregate living facilities. Bivariate analyses will include ANOVAs and t-tests as appropriate depending on the nature of the independent and dependent variables. Independent variables will be included in the multivariate analyses if they are significantly ($p < 0.05$) or marginally significantly ($0.05 < p < 0.10$) related to the dependent variable. Independent variables will be examined for multicollinearity (variance inflation factor > 5) before inclusion in regression models. Multivariate analyses will include multilevel mixed-effects generalized linear regression models examining factors that predict the number of COVID-19 cases and deaths while controlling for characteristics of facilities and communities. Analyses will be performed in Stata Version 15.1. The PI has employed similar analytic techniques on multiple completed federally-funded research projects. We will seek IRB approval prior to study initiation.

Deliverables / Dissemination Strategy. Following community-based participatory research, we will convene a Stakeholder Advisory Board with 6-8 key stakeholders during the research process. The Board will provide feedback on the approach, analysis interpretation, and help develop actionable recommendations for strategies that can be implemented to mitigate COVID-19 cases and deaths in congregate living facilities. The Board will provide feedback on deliverable formats that can best meet the needs of our local community partners, their constituents, policymakers, and decision makers (e.g., issue briefs, reports, community presentations), so that research can be translated to inform practice. We will also develop manuscripts and conference presentations for academia.

Timeline. A high-level timeline is provided in *Figure 1.*

Figure 1. High-Level Timeline.

Activity	Jun 2020	Jul 2020	Aug 2020	Sep 2020	Oct 2020	Nov 2020	Dec 2020
Task 1. Data Source Compilation							
Data Management (Compilation, Merging, Cleaning)	X	X					
Task 2. Data Analysis							
Data Analysis		X	X	X	X	X	
Task 3. Deliverables / Dissemination Strategy							
Recruitment of Stakeholder Advisory Board	X	X					
Convening of Stakeholder Advisory Board		X		X		X	
Recommendations Development				X	X	X	
Translation of Key Findings for Partners, Constituents, Policymakers, and Decision-makers (e.g., Issue Briefs, Reports, Community Presentations)						X	X
Development of Deliverables for Academia (e.g., Peer-Reviewed Manuscripts and Conference Paper Submissions)						X	X
Task 4. Project Management							
Project and Quality Management	X	X	X	X	X	X	X
IRB Approval	X						

High-Level Budget: $71,428

Personnel: $33,875 PI/Grad Students (Sum. & Academic)
Fringe: $6,925 PI/Grad Students
Non-personnel: $20,190 Travel, Materials & Supplies, etc.
Tuition: $10,438
Total: $71,428

Assistant Professor, Computational Science and Engineering

Designing an Anti-Viral Nanoparticle Against SARS-CoV2

Project narrative:

The recent emergence of the novel, pathogenic SARS-coronavirus 2 (SARS-CoV-2) and its rapid national and international spread pose a global health emergency. Coronavirus infection depends on binding of the viral spike (S) proteins to cellular receptors on the surface of the target cells. Of utmost importance is the ability to create an antiviral that can block viral entry into host cells. Metallic nanoparticles (silver (AgNP), copper (CuNP), iron (FeNP) and ions have recently emerged as novel antiviral agents against numerous viruses, but their antiviral activity against coronaviruses have not been investigated. Carbon based nanomaterials such as carbon nanotubes, graphene and fullerenes have been effective against other viral agents. We hypothesize that metallic nanoparticles and carbon-based nanomaterials can bind to and inhibit the spike protein of coronaviruses from interacting with the cellular receptor on host cells. **The goal of this study is to obtain insights into the use of metallic nanoparticles and carbon-based nanomaterials as a coating for surfaces and filters to block coronavirus binding to its targets and gain entry into host cells.** The combination could be used as an additive to everyday materials, such as fabric, as potential PPE products to prevent virus infection. We are uniquely positioned to complete this project as the Jeffers-Francis lab have shown that viruses (bacteriophage) when exposed to ionic Fe(III), significantly reduces viral infectivity and. Dr. Rhinehardt has been successful in modeled ionic silver and copper with protein receptor targets.

Deliverables:

We expect to develop a novel antiviral that can block coronavirus infectability by blocking its ligand spike protein from attaching to the host cell receptor. This could lead to an aerosolized or topical compound that can be used in the built environment as a protective shield to fight against viral pathogen attack or can be in used in fabric to prevent viral infection. We expect to (**1**) derive via computational modeling the optimal metallic nanoparticle (Ag, Fe, Cu) or carbon-based nanostructure that binds to coronavirus spike protein.
(**2)** verify the computational model by combining the coronavirus spike protein with the metallic nanoparticle and/or carbon-based nanostructures in vitro and (**3**) determine the toxicity of the antiviral agents on host human cells using an in vitro tissue culture model.

Timeline:

June - August: Computational simulations
August - October: In-vitro binding study
October - December: Host cell toxicity assay

Budget:

	Details	**Cost**
A. Senior Personnel	AY effort to all PI's	$10,726
B. Other Personnel	3 graduate; 1 undergrad students	$34,560
C. Fringe Benefits	36% full; 7.65% part time	$4,522
D. Materials & Supplies	Aptamers, ACE2 protein, Software	$56,360
E. Contract Services	Lab service and publication fees	$8,500
F. Tuition	3 graduate students	$15,732
Total Costs		**$130,400**

COVID-19 – NC Policy Collaboratory **Lead PI**: Lifeng Zhang, Associate Professor, Nanoengineering
North Carolina A&T State University **Co-PI**: Kristen Dellinger, Assistant Professor, Nanoengineering

Portable Sensing Platform for Rapid Detection of SARS-CoV-2 Virus in Air Through Nanoengineered Surface Enhanced Raman Scattering

Brief Statement of Work: With the outbreak of COVID-19, a significant challenge in the coming months is to have a convenient, rapid, sensitive, and reliable surveillance tool to detect the SARS-CoV-2 virus in air so as to ensure a safe environment both indoors and outdoors. This project aims to develop a portable sensing platform that captures SARS-CoV-2 virus in air and accurately test it in minutes via surface-enhanced Raman scattering (SERS). Specifically, the project will design and prepare flexible polymer nanofibrous materials with filtration porosity engineered for SARS-CoV-2 capture through an electro-spinning-netting technique followed by silver (Ag) nanoparticle growth on the nanofiber surface for Raman signal enhancement.

Task I. Electro-spinning-netting Electrospinning is a straightforward and universal technique to acquire fibers with diameters generally in the submicrometer range for a wide range of applications, particularly air filtration. According to the size of SARS-CoV-2 virus, i.e. ~125 nm, the electrospinning process will be modified to generate a flexible polymer nanofibrous mat with appropriate inter-fiber porosity. Specifically, this novel material will contain 2D nanostructured networks with fiber diameters of a few tens of nanometers as collector for effective viral capture.

Task II. Growth of Ag nanoparticles for SERS SERS is a phenomenon based on amplification of Raman signal of molecules when they are adsorbed or in close proximity (~10 nm) to nanostructured assemblies with significant potential in the field of biosensors, often yielding single molecule detection. When SARS-CoV-2 viruses are trapped between certain Ag/nanofiber arrays, Raman signal of the viruses can be enhanced by up to $\sim 10^8$ and the viruses are thus detectable. The growth of Ag nanoparticles on nanofiber surface will be engineered to enable certain array patterns for sensitive SARS-CoV-2 detection. **Task III. Portable SARS-CoV-2 detection** A reliable average Raman spectrum fingerprint for the SARS-CoV-2 virus will be generated by recording Raman signals of pure virus samples. Detection of the virus will be realized using a portable Raman spectrometer (PRS) by waving a virus collector made with our nanoengineered fibrous material in air followed by inserting the collector onto a PRS. Upon a matching Raman spectrum fingerprint of SARS-CoV-2, a positive detection is achieved.

The proposed platform is universal. In case of potential viral mutations, new fingerprint Raman spectra can be readily generated from these new species. This platform is not only usable to monitor air quality, but also can be used to confirm COVID-19 infection by simply collecting samples from patients' coughing and sneezing. This test method will outperform the current diagnostic COVID-19 test based on genetic information (RNA), which can result in lengthy turnaround time and/or inaccurate result.

Timeline: The proposed project will start June 8, 2020 and end Dec. 30, 2020. Task I will be mostly carried out from June through August, Task II will be mostly performed from August through October, and Task III will be mostly executed from October through December. The three tasks are correlated and integrated toward the final goal of developing an effective system for rapid and non-PCR based viral detection.

Deliverables: The PIs have abundant track record in nanomaterials, SERS, and biosensing. The Joint School of Nanoscience and Nanoengineering (JSNN) has all the facilities needed to synthesize the nanofibrous materials and work with BSL2 and BSL3 viruses. Upon successful completion of the project, we will have enabled a portable sensing platform for rapid detection of SARS-CoV-2 virus in air for safe environment as well as fast test for COVID-19. The project will also generate new knowledge and benefit research in the field of bio-sensors.

High-level Budget: Funds are requested to support 2 month summer salaries for the PIs with 36% fringe benefit at ~$50,000, summer stipend for 2 Ph.D. students at $6,000, Fall 2020 tuition, fees and health insurance for 2 Ph.D. students at ~$25,000, Fall 2020 stipend for 2 Ph.D. students at $20,000, NanoRam Handheld Raman System (VWR) at ~$79,000, materials, supplies & miscellaneous cost at $20,000 with total budget of $200,000.

Lead PI (Cephas Naanwaab, Associate professor, Economics); Co-PI (Alfredo Romero, Associate professor, Economics); Co-PI (Scott Simkins, Associate professor & Chair, Economics)

Project title: Economic Impact of COVID-19 in the Piedmont Triad Region

Statement of Work

The Coronavirus pandemic is impacting all dimensions of life, from how we live, work and shop to how we travel and entertain. The resulting economic disruption transcends national, state, and local boundaries. At present the economic toll in terms of lost jobs and output is staggering: more than 40 million Americans have already filed for first-time unemployment claims, while the unemployment rate has soared to 15% and is likely to remain at double-digit levels well into 2021, according to Congressional Budget Office projections. Output, income, and tax revenues have fallen sharply, likely necessitating state and local budget cuts that limit prospects for a quick economic rebound.

For our state, over one million people have filed for unemployment claims while in the Piedmont Triad area the economic picture thus far appears to be worse than for the state, making it likely that the unemployment rate within the Piedmont Triad will be higher than the state average. This might result in a severe contraction in the economic outlook in revenue and income for businesses, households, and local governments in the region. This imposes serious challenges to NC A&T normal operations with repercussions on the university's economic influence in the region.

This project has two objectives: 1) to assess the economic impact of COVID-19 on businesses, households, and local/municipal governments in the Triad; 2) to assess the economic impact of several scenarios of the impact of the disruption of NC A&T normal operations in the Triad Area, ranging from total closure to complete normal operations.

Innovation of the study: This study will produce unique estimates of the impact of disruptions to North Carolina A&T State University operations on the surrounding community. This information will be valuable to decisionmakers for the calculus of cost/benefit analysis in the event of future shutdowns.

Methodology: The study will use IMPLAN, an industry tested economic impact modeling system with an input-output framework that uses multipliers and regional social accounting matrices to calculate regional economic impact of events.

Deliverables: The study will generate estimates of the economic impacts of disruptions to NC A&T SU as well as COVID-19-induced unemployment/job losses on output/production, incomes, and tax revenues in the Piedmont Triad region of North Carolina. A report of study findings will be produced.

Project Timeline:

Activity	**Proposed completion date**
Review previous economic impact studies	July 31, 2020
Collection of data	September 30, 2020
Economic Impact modeling	November 15, 2020
Deliverables: Reports of impact analysis results	December 30, 2020

High-level Budget:

Labor costs:

Salaries and fringe benefits	$10,500 * 2 + 6,500 * 1 =	$27,500
Epidemiologist Consultant		$5,000
Student Assistants	$2,500 * 2 =	$5,000

Non-Labor costs:

Survey data		$5,000
IMPLAN Workshop	$1,500 * 2 =	$3,000

Materials:

Office supplies and equipment	$2,500

Grand Total **$48,000**