Women's Giving Circle Grant Application

Instructions:

1. Complete all information in the grant proposal application.
2. Adhere to recommended text limits as indicated
3. Define any acronyms that are used in the proposal.
4. Upload the WGC Grant Application Budget Request Sheet as the final page of this application.
5. Please note that the WGC will not accept repeat applications beyond more than two consecutive years.
6. If you have questions, contact your unit's development officer for any clarifications or assistance in preparing your proposal.
7. Applications are due to the Women's Giving Circle by 5:00 p.m., May 15, Monday. Please deliver your application to your dean or development officer for review and approval prior to the submission deadline. We advise you to give these individuals sufficient time to make recommendations for changes and allow yourself time to execute them.
8. Remember to save a copy of your proposal before final submission.
9. We ask that you keep the following aspects of the Women's Giving Circle grant program in mind as you complete your application:

Women's Giving Circle Mission

To support innovative programs and research at the University of Arkansas

Women's Giving Circle Vision

To engage and empower women as philanthropic leaders at the University of Arkansas

Women's Giving Circle Funding Priorities

Support and promote scholarship, research, and service
Enrich the quality of life of women and children
Encourage outreach and engagement in Arkansas

Areas that meet the strategic priorities for the university and the WGC

- Focus on retention/graduation
- Increase undergraduate opportunities, i.e., building the endowment; involving students in research or service learning project with a collaborative bent
- Promote graduate student participation in research
- Focus on collaboration
- Follow the land grant mission to fund projects that support needs in the region and the state with emphasis on collaboration between colleges/departments/units
- Invest in faculty excellence
- Recruit first-generation students from Arkansas
- Advance the mission of the WGC

Identifying Information:

College or Unit Affiliation

Dale Bumpers College of Agricultural, Food and Life Sciences
Fay Jones School of Architecture and Design
J. William Fulbright College of Arts and Sciences
Sam M. Walton College of Business
College of Education and Health Professions
College of Engineering
Honors College
Graduate School and International Education
School of Law
Student Affairs
University Libraries
Other

*Please specify **OTHER** unit affiliation:* College of Engineering

Title of Proposal: Novel ultrasound technique in children with heart defects

Primary Contact and Title: Hanna Jensen, Research Assistant Professor

Primary Contact E-mail: hkjensen@uark.edu

Primary Contact Phone Number: 404-834-2197

Project Summary (200 word maximum)

In children born with heart defects, non-invasive, pain-free, bed-side imaging methods are essential in diagnosis and routine follow-up. Traditional ultrasound forms the golden standard of bedside monitoring that does not require any type of sedation, but it has limitations in certain populations. Supravalvar aortic stenosis (SVAS) is a critical narrowing of the biggest blood vessel in the body, and often presents in children born with a genetic disorder called Williams syndrome. Whether SVAS requires surgical correction or not is often determined by ultrasound (as these children are extremely high-risk for any sedation / general anesthesia), which unfortunately tends to overestimate the severity of the narrowing, potentially leading to premature surgery. In collaboration with the Arkansas Children's Hospital, we are testing a novel ultrasound method called Vector Flow Imaging (VFI), which gives more detailed information about blood flow through this narrowing. We aim to replicate the patient-specific blood vessel anatomy using a 3D printing method, and compare our VFI findings about the severity of the problem to routine clinical findings. Our aim is to show that this commercially available technology can provide superior data compared to routine ultrasound, and can help clinicians in the decision of when surgery is indeed necessary.

Is this:

- ○ an expansion of a current program
- ● a new program

Please list media sites (if any) utilized by your project or program to publicize the project/program, i.e., website, social media, etc?

The results, once published, will likely be featured on the UA biomedical engineering website as well as the social media profiles related to it; potentially in the UA Newswire; in the Arkansas Children's Research Institute Intranet as well as the Jensen Cardiovascular biomechanics laboratory website (https://cblab.uark.edu/) and the AM3 Lab (Dr. Wenchao Zhou's laboratory) website.

If your project is funded, describe innovative ways how the WGC will be recognized in the success/completion of your project?

This project is expected to result in several journal publications, all of which would include the information about funding sources acknowledging the WGC. Similarly, as results of this proposal would be presented in scientific conferences, funding sources are always disclosed and acknowledged. Any larger grant application made within this project would include the funding agency that helped this project lift off the ground, crediting the WGC. The support from WGC would be clearly acknowledged throughout the lifetime of this project, not only limited to the one year that support is potentially on-going. The UA investigators would also list WCG as a sponsor of research on their websites.

Grant Proposal

What is the specific scholarly or community needs your grant request addresses? (100 word maximum)

Supravalvar aortic stenosis (SVAS) is present in 70% of children born with a genetic disorder called Williams syndrome. To avoid multiple re-operations on the same patient due to growth, it is always in the child's best interest to postpone surgical repair until the latest possible time point. The decision to operate is often made with Doppler ultrasound, which tends to overestimate pressure gradients across the stenosis especially in children with abnormal aortic arch geometries. A more accurate, non-invasive, bedside-style imaging method is needed as sudden death can occur in these children under general anesthesia or sedation for magnetic resonance imaging or computer tomography.

How does your proposed project or program assess how these needs will be redressed? *(100 word maximum)*

Williams Syndrome affects 1 in 10,000 people worldwide - it occurs equally in both males and females and consistently in every culture and race. Our aim is to develop a tool that helps the treating physicians more accurately assess the need for surgery in children. The goal is to be able to determine the optimal timing of the operation; this is the point when irreversible damage to the heart muscle has not yet occurred as a result of the increased pressure required to pump blood through the narrowed artery, yet also the point when the outcome of the surgical repair would last as long as possible as the child grows.

Describe any unique and/or innovative aspects of your project or program that improves what is already known about your area of inquiry. *(100 word maximum)*

Vector flow imaging (VFI) ultrasound has not been previously utilized in cardiology. We have, however, demonstrated together with Arkansas Children's Hospital, that VFI ultrasound can feasibly be done in a pediatric-sized laboratory animal (piglet), as well as in human infant patients, to more accurately assess heart and vessel anatomy and function. We hope our research effort helps this technology to advance to the cardiac field. Furthermore, 3D printing of human tissue for this application has not been done previously - and we have over the last year developed a print head for printing a gel-material that can imitate human blood vessel wall.

Please list up to five (5) expected outputs and outcomes with corresponding measurements. (Please note: just listing outputs is not sufficient.)

1. Building 5 human-vessel-like cardiovascular phantoms with SVAS based on anonymous patients' data. These phantoms will be assessed against each patients' computer tomography (CT) and/or magnetic resonance imaging (MRI) information to make sure all dimensions and measurements are identical to the patient.
2. Constructing a flow-loop through the phantoms that imitates the physiological blood flow in each patient. We will compare the clinical data from each patient (ultrasound / angiography imaging / CT / MRI) to ensure our phantoms are physiologically relevant and correct.
3. Acquiring detailed flow-and pressure information of each phantom from direct flow and pressure measurements as well as VFI ultrasound and particle imaging velocimetry (PIV), and comparing it to clinical assessment of the physiology. We want to assess the pressure change in the narrowing of the vessel in multiple ways to investigate whether VFI provides more accurate non-invasive assessment than traditional ultrasound.

Document if there are other programs/projects that attempt to address the same needs as your proposal. If so, describe whether and how you will collaborate with them.*(100-word maximum)*

Currently no one else, to our knowledge, is pursuing Vector Flow Imaging in pediatric cardiology. VFI has thus far been utilized mostly in applications where the target blood vessel is fairly superficial such as the carotid artery or the femoral vein. We will have two main collaborators on this project; the Arkansas Children's Hospital (ACH) and the department of Mechanical Engineering at the U of A. ACH is a nationally recognized center for treating patients with Williams syndrome, spearheaded by Dr. R. Thomas Collins, who is a co-investigator on this proposal. ACH has recently purchased a VFI ultrasound machine. Dr. Wenchao Zhou from MEEG has developed a new 3D printing process for a clear human-flesh-like gel with unique properties that make it an ideal material for making human models and will be responsible for the state-of-the-art 3D printing of human cardiovascular phantoms.

Demographic Considerations

First generation students engaged in the project: ○ Yes ◉ No

Number of current UA students engaged in the project: 5

Geographic region served:

- ◉ Northwest Arkansas
- ○ Southwest Arkansas
- ○ Northeast Arkansas
- ○ Southeast Arkansas
- ○ Central Arkansas
- ○ Campus

Budgetary Considerations

Have you received WGC Funding before?

- ○ Yes
- ◉ No

Please provide the year(s) and project name(s).

Total proposed budget for project or program: (proposed budgets of more than $20K will not be considered; in typical years WGC proposals fall within in the $5-10K range):
$ 15000

Should match Item 1 on Budget Request sheet.

Please list total funding commitments from external or campus sources to date:
$ 41,900

Should match Item 2 on Budget Request sheet.

How much, if any, of your request involves funding for the following?

Please estimate using percentages

Student Compensation: 0 %
Equipment: 53 %

Total funds requested from WGC Grant:
$ 15000

Should match Item 3 on Budget Request sheet.

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With the preliminary results from the 5 phantoms, we plan to submit a proposal to American Heart Association for a Grant-in-aid (South West Affiliate) in early 2018, aimed at enabling the testing of our imaging protocol and algorithms in a piglet model of SVAS. After we have completed research in a laboratory setting and in an animal model, and established a common track-record with our collaborators at Arkansas Children's Hospital, our target organization for funding will be the National Institute of Health through the R01 program, with the aim of establishing routine use of VFI technology in various lesions in pediatric cardiology.

In the rare case that grant resources cannot be expended, be prepared to return the remaining funds to WGC.

If selected as a recipient for a WGC grants, you will be required to submit two progress reports, including a budget summary, as well as a poster of your project for purposes of grant presentation.

Please be sure to save this document within the Grant Application Packet.