TOBACCO SETTLEMENT REVENUE OVERSIGHT COMMITTEE

TOBACCO SETTLEMENT REVENUE (TSR) FUNDING REQUEST

Name of entity requesting TSR funds: _____New Mexico State University_____

Name(s) of each program for which TSR funds will be used:Dept of Engineering COPD Reseach_____

Description of each program, including its purpose: _____

___Please see attached_____

_____

_____

Have you requested TSR funds prior to this request? Yes (No)

Have you received TSR funds prior to this request? Yes (No)

If yes, in what fiscal years? _____

What will you use the requested funds for? Please include goals and objectives.

_____

_____Please See Attached_____

_____

_____

Is this a change from previous years' use? Yes (No)

If yes, please describe the change and reason(s): _____

_____

_____

_____

Amount requested (Total amount, and amount for each program):

_____$100,000_____

What other sources of funding are applied to this purpose?

_____

Name, title, telephone, email and mailing address of contact person:

____Vicente Vargas, Director, State Goverment Relations, 505-710-8560, v_vargas@nmsu.edu_

_____

Date: _____11.15.2017_____

COVER PAGE FOR NM TOBACCO SETTLEMENT GRANT APPLICATION

Project Title: Utilization of portable assisted mobility device to increase activity levels of COPD patients for effective management strategy and long-term health improvement

	Names	Affiliations
Principal Investigator:	Dr. Young Ho Park	Mechanical & Aerospace Engineering (MAE) Department
Co-Principal Investigator:	Dr. Delia Valles-Rosales	Industrial Engineering (IE) Department
	Dr. Patricia Sullivan	College of Engineering/ Aggie Innovation Space (AIS)
	Mr. Kenneth Ruble	MAE Student Project Center

Total Budget Requested: $100,000

Period of Performance Requested: Start____7/1/2017____ End ____6/30/2018____

PROJECT SUMMARY:

Chronic obstructive pulmonary disorder (COPD) commonly occurs in people who have a history of smoking. COPD is a debilitating disease affecting patients in daily life, both physically and emotionally. Symptoms such as dyspnea and muscle fatigue, lead to exercise intolerance, which, together with behavioral issues, trigger physical inactivity, a key feature of COPD. It is essential, however, to keep patients' mobility for both their mental and physical health. A motorized mobility device allows COPD patients to take parts in outdoor activities, meeting friends, dinning out & maintaining their independent lifestyle. It also helps COPD patients to re-integrate themselves into the society, hence improves their quality of life. Current motorized mobility devices such as electric wheelchair and electric scooter are too heavy for people with disabilities to lift a device and often need a carrier on the back of a vihecle, which make it problematic for short trip for shopping or quick stops. The objective of the proposed research is to design and fabricate a prototye portable assisted mobility device (PAMD) for COPD patients. This device is ultralight and compact and has the ability to fold into the size of a carry-on luggage. The PAMD will be a personal gadget that can take one person and medical unit such as an oxygen tank per trip, fitting perfectly on the neccessities of a COPD patient. A special focus will be on a rider's comfort and saefty. Digitial human models will be utilized to incorporate the ergonomic aspects into the PAMD design to ensure the safety, efficiency and comfort of the rider. Posture and reach-ability will be tested in correlation with steering, seating and foot support so that a rider can be ergonomically placed in the vehicle, without putting too much stress and strain on different areas of the arms, back, and shoulder. The static and dynamic stability will be evaluated to ensure a rider's safety. The proposed project has a potential to launch an inexpensive PAMD that can increase activity levels of COPD patients, which is crucial for effective management strategy and could lead to improved long-term outcomes. People with disabilities will be invited to participate in survey of user feedback for the PAMD prototype. This project will provide product tests of meaningful scale to allow for technology transfer that benefits public health in New Mexico.

Specific Aims

The goal of the proposed project is to design and fabricate a prototype portable assisted mobility device (PAMD) for chronic obstructive pulmonary disorder (COPD) patients. Staying active is especially important for treatment of COPD patients, and motorized mobility device can help COPD patients maintain the mobility they need for an active lifestyle. In this project, we envision a portable mobility device that is ultralight and compact to fit inside public transportation or a vehicle and that can be carried or stored, and that is safe and comfortable to ride. This mobility device enables COPD patients to take parts in outdoor activities, meeting friends, dinning out & maintain their independent lifestyle. The PAMD also helps COPD patients to re-integrate themselves into the society, hence improves their quality of life. Ergonomic analysis using digital human models will ensure safe and efficient use of the device. People with disabilities will be invited to participate in survey of user feedback for the PAMD prototype. This project will provide product tests of meaningful scale to allow for technology transfer that benefits public health in New Mexico.

Project Strategy

Significance

Chronic lower respiratory disease, including COPD, is the third leading cause of death in the United States [1]. According to the World Health Organization (WHO), smoking is the primary cause of COPD [1]. 6.1% of New Mexico residents surveyed in 2011 reported having been told by a health care professional that they have COPD [2]. COPD is a debilitating disease affecting patients in daily life, both physically and emotionally. Symptoms such as dyspnea and muscle fatigue, lead to exercise intolerance, which, together with behavioral issues, trigger physical inactivity, a key feature of COPD [3]. It is essential, however, to keep patients' mobility for both their mental and physical health. The proposed PAMD permits patients to get out of the confines of their home and be able to exercise some degree of independence. Motorized mobility devices are available in market that help people with disabilities maintain the mobility for an active lifestyle such as electric wheelchairs and electric mobility scooters. Electric wheelchairs are primarily designed to operate indoors. They tend to be quite heavy. In order to get the wheelchair outside, ramps are usually required. Since they do not breakdown for transport, patients must have a lift on the back of their car. Mobility scooters are designed for outdoor use. However, carrying the scooter in the back of an SUV or truck or a carrier on the back of the vehicle still means patients to dismantle or lift it out, which make it problematic for short trip for shopping or quick stops. The ability of the device to be portable can transport patients to other locations of mass transportation or to their desired final destinations. The proposed project has a potential to launch an inexpensive PAMD that can increase activity levels of COPD patients, which is crucial for effective management strategy and could lead to improved long-term outcomes.

Innovation

An average power wheelchair can weigh anywhere from 150 to 250 lbs. A four wheel power scooter is around 350 to 400 lbs. The proposed PAMD is ultralight (less than 50 lbs) and durable (about 250 lbs weight capacity). The device will be built with a lightweight and strong material and can be folded into the size of a carry-on luggage. Compared to other motorized mobility devices the PAMD will be light in weight, small, and be able to be carried by other transportation while having the ability to be stored in small places, all the while maintaining the same pay load and velocity capacities in a more compact design. American anthropometric measurement data will be incorporated into the PAMD design, which would allow 90 % of US population to ergonomically interact with the device. Human factors engineering enables the PAMD to have the ability to securely carry small cargo while the passenger sits with an ergonomically relaxed posture preventing any disconformities. The static and dynamic stability will be evaluated to ensure a rider's safety. The proposed device will use an electric motor for propulsion and the energy will be supplied by a battery.

Approach

The PIs have been involved in Partners for the Advancement of Collaborative Engineering Education (PACE) CubO project sponsored by General Motors, Autodesk, HP, Siemens and Oracle. The CubO is a portable vehicle which can fold into the size of a small carry-on luggage case with a weight of 35 lbs and acquire a top speed of 15 mph while unfolded. The CubO was designed to travel short distances, such as a trip from the bus stop or train station to the final location. This concept of vehicle is called "first mile-last mile".

Figure 1. First mile-last mile concept and CubO design

Deployment mechanisms of the wheel, the seat, foot rests, and steering of the CubO were developed and tested. Human factors were considered by using a human modeling and simulation software "JACK" to optimize the system and all the elements the user interacts with in the driving condition. A full scale mockup was built and the final design was validated in the CubO project.

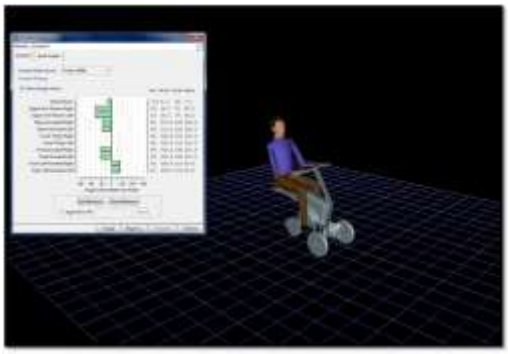

Figure 2. Digital human model and ergonomic analysis using Jack

The working deployment mechanisms and human factor practices used in the CubO design will be implemented into the design of the proposed PAMD. The PAMD will be a personal gadget that can take one person and medical unit such as an oxygen tank per trip, fitting perfectly on the necessities of a COPD patient. A special focus will be on the rider's comfort and safety. The seat will be designed to maximize comfort for prolonged time duration. Posture and reach-ability will be tested in correlation with steering, seating and foot support so that a rider can be ergonomically placed in the vehicle, without putting too much stress and strain on different areas of the arms, back, and shoulder. Human factors analysis will be performed using digital human models in JACK to ensure that the design is ergonomically sound, with minimal fatigue due to the rider's posture. For safe driving, the maximum voltage over the motor will be limited in function of the steering angle by adding a sensor in the handlebar to detect its angle. In order to select the best materials to manufacture it, durability, comfort, accessibility, and weight will be taken into account. Most of the components used in the PAMD prototype are standard parts that can be purchased from external suppliers. Special parts will be either machined in the Mechanical & Aerospace Engineering Student Project Center or built by 3D printers in Aggie Innovation Space (AIG). Table 1 shows the project timeline and overall tasks involved in the proposed project.

Table 1. Project timeline

Task (PIs)	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Conceptual design (Park, Valles, Sullivan, Ruble)												
Preliminary design (Park, Ruble)												
Ergonomic analysis (Valles, Sullivan)												
Engineering analysis (Park)												
Detailed design (Park)												
Prototype manufacturing (Ruble)												
Test												

References

1. Kochanek K.D., Xu J., Murphy S.L., Miniño A.M., Kung H.C. Deaths: final data for 2009. Nat Vital Stat Rep. 2012; 60(3): 1-117.
2. Behavioral Rick Factor Surveillance Survey (BRFSS). 2001.
3. Troosters, T. et al. Improving physical activity in COPD: towards a new paradigm. Respiratory Research. 2013; 14: 1-8.

NM TOBACCO SETTLEMENT APPLICATION BUDGET TEMPLATE
New Mexico State University

Principal Investigator Young Ho Park .

PERSONNEL		Months Devoted to Project					
NAME	ROLE ON PROJECT	Cal. Mnths	Acad. Mnths	Summer Mnths	DOLLAR AMOUNT REQUESTED (INCLUDING F&A)		
Dr. Young Ho Park	P.I.			1	5,749	2,759	8,508
Dr. Delia Valles Rosales	Co. P.I.			1	5,676	2,724	8,400
Dr. Patricia Sullivan	Co. P.I.	.25			3,556	1,707	5,263
Kenneth Ruble	Engineer	1			5,460	2,620	8,080
Graduate Assistant Annual Appt. @20 Hrs. Wk	Assistant	6			21,273	10,211	31,484
Undergraduate Assistant Acad.Appt. 10 Hrs.Wk	Assistant	4.5			5,055	2,426	7,481
	SUBTOTALS Salary/Fringe/IDC @48%				$46,769	$22,448	$69,216

EQUIPMENT			
SUPPLIES	Materials for Fabrication	$13,000	
	Materials for Protype	$7,800	
	F & A @ 48%	$9,984	
			$30,784
TRAVEL			
OTHER EXPENSES			
TOTAL BUDGET			**$** 100,000