Back to Search Results

Description

Details

Sub-Projects

Publications

Patents

Outcomes

Clinical Studies

News and More

History

Similar Projects

# Development of a Universal Influenza Vaccine Against Influenza A and B Viruses

**Project Number**
1R01AI137846-01A1

**Contact PI/Project Leader**
GILL, HARVINDER SINGH

**Awardee Organization**
TEXAS TECH UNIVERSITY



## Description

### Abstract Text

Development of a Universal Influenza Vaccine Against Influenza A and B Viruses Influenza virus causes widespread mortality and morbidity every year. In addition, the threat of an influenza **pandemic** continues to persist. For current seasonal licensed vaccines to be effective the influenza strain in the formulation should match that which is circulating in the human population. Unfortunately, making a prediction of the influenza strains that are likely to circulate in the human population in the future is not very reliable. As a result, an error in this prediction can make the vaccine ineffective. This unreliability of the vaccine exists because the vaccine is based on one of the most abundant membrane proteins called hemagglutinin found on the influenza virus surface. Because hemagglutinin changes from one strain to the next, a proper match between circulating influenza strains and that in the vaccine is important. Furthermore, because the identity of a future **pandemic** strain cannot be predicted, it is hard to develop a vaccine for **pandemic** influenza based on hemagglutinin's head region as an antigen. To overcome the limitation of the current vaccine design we propose to use highly conserved antigens to formulate an influenza vaccine. One of these conserved antigens is from the ion channel membrane protein called matrix 2 (M2). The domain of M2 exposed on the surface of the virus is called M2e, and it has remained highly conserved in human influenza A strains. By attaching consensus human M2e on the gold nanoparticle surface we have shown breadth of protection against H1N1 and H3N2 influenza A strains, and even the highly pathogenic avian influenza strain H5N1. The vaccine was however only partially protective against the highly pathogenic avian influenza A H7N9 strain. The reason is that M2e on avian and swine influenza strains shows some dissimilarity from M2e of human influenza strains. Therefore, we propose that inclusion of M2e of human, avian and swine influenza strains as the vaccine antigen will increase the breadth of protection. The second conserved antigen is an epitope from the neuraminidase membrane protein of the influenza virus. This epitope is conserved across influenza A and B strains. We hypothesize that inclusion of both M2e and the conserved neuraminidase epitope will help to design a universal influenza vaccine protective against a broad range of strains. Our specific aims are: AIM 1: Develop the multi-antigen vaccine formulation, and establish its breadth and longevity of protection in Balb/c mice. AIM 2: Characterize the role of humoral and cellular immunity in the mechanism of protection, and assess biodistribution and safety profile of the vaccine. AIM 3: Establish vaccine efficacy in ferrets, and evaluate vaccine thermal stability. The influenza vaccine designed through this research is expected to have a broad and significant impact on public health. If successful, the vaccine will offer broad protection against both influenza A and B strains, eliminating the need for seasonal vaccines, and significantly reducing the threat of **pandemic** outbreaks due to influenza virus.

### Public Health Relevance Statement

NARRATIVE This project focuses on the development of a universal influenza vaccine that can enable protection against all influenza A and B strains, thus eliminating the need for yearly vaccinations against influenza, and the threat of influenza pandemics. Successful completion of the project may in the long run reduce much morbidity, especially amongst elderly and children.

### NIH Spending Category

Biodefense Bioengineering Biotechnology Emerging Infectious Diseases Immunization Infectious Diseases Influenza Nanotechnology Pneumonia & Influenza Prevention Vaccine Related

### Project Terms

Allergen Immunotherapy Amino Acid Sequence Amino Acids Antibodies Antibody titer measurement Antigens Antiviral Therapy Avian Influenza B-Lymphocytes Binding Biochemistry Biodistribution Birds Blood Cells Cellular Assay Cellular Immunity Child Complement Complex Consensus Consensus Sequence Development Disease Outbreaks Dose Elderly Enzyme-Linked Immunosorbent Assay Epidemic Epitopes Extracellular Domain Family suidae Ferrets Formulation Freeze Drying Future Gills Gold Growth Head Hemagglutinin High temperature of physical object Human Humoral Immunities Immune Immunity In Vitro Inbred BALB C Mice Inbred Mouse

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Back to Search Results

Description
Details
Sub-Projects
Publications
Patents
Outcomes
Clinical Studies
News and More
History
Similar Projects

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**Project Number**
1R01AI137846-01A1

**Contact PI/Project Leader**
GILL, HARVINDER SINGH

**Awardee Organization**
TEXAS TECH UNIVERSITY

Title
**ASSOCIATE PROFESSOR**

Contact
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Contact
jennifer.gordon2@nih.gov

## Organization

Name
**TEXAS TECH UNIVERSITY**

City
**LUBBOCK**

Country
**UNITED STATES (US)**

Department Type
**ENGINEERING (ALL TYPES)**

Organization Type
**BIOMED ENGR/COL ENGR/ENGR STA**

State Code
**TX**

Congressional District
**19**

## Other Information

FOA
PA-18-484

Study Section
Gene and Drug Delivery Systems Study Section[GDD]

Fiscal Year
**2019**

Award Notice Date
**09-November-2018**

Administering Institutes or Centers
**NATIONAL INSTITUTE OF ALLERGY AND INFECTIOUS DISEASES**

DUNS Number
**041367053**

CFDA Code
**855**

Project Start Date
**12-November-2018**

Project End Date
**31-October-2023**

Budget Start Date
**12-November-2018**

Budget End Date
**31-October-2019**

## Project Funding Information for 2019

Total Funding
**$716,192**

Direct Costs
**$530,756**

Indirect Costs
**$185,436**

| Year | Funding IC | FY Total Cost by IC |
|---|---|---|
| 2019 | NATIONAL INSTITUTE OF ALLERGY AND INFECTIOUS DISEASES | $716,192 |

## NIH Categorical Spending

Click here for more information on NIH Categorical Spending

| Funding IC | FY Total Cost by IC | NIH Spending Category |
|---|---|---|
| NATIONAL INSTITUTE OF ALLERGY AND INFECTIOUS DISEASES | $716,192 | Biodefense; Bioengineering; Biotechnology; Emerging Infectious Diseases; Immunization; Infectious Diseases; Influenza; Nanotechnology; Pneumonia & Influenza; Prevention; Vaccine Related; |

## Sub Projects

No Sub Projects information available for 1R01AI137846-01A1

## Publications

No Publications available for 1R01AI137846-01A1

## Patents

No Patents information available for 1R01AI137846-01A1

Back to Search Results

Description

Details

Sub-Projects

Publications

Patents

Outcomes

Clinical Studies

News and More

History

Similar Projects

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| Project Number | Contact PI/Project Leader | Awardee Organization |
|---|---|---|
| 1R01AI137846-01A1 | GILL, HARVINDER SINGH | TEXAS TECH UNIVERSITY |

No Outcomes available for 1R01AI137846-01A1

## Clinical Studies

No Clinical Studies information available for 1R01AI137846-01A1

## News and More

### Related News Releases

No news release information available for 1R01AI137846-01A1

## History

No Historical information available for 1R01AI137846-01A1

## Similar Projects

No Similar Projects information available for 1R01AI137846-01A1