

Quantitative Assessment of Varicella Stages in Severe Dermatologic Manifestations

Faculty Development Funded Project Proposal

for Summer 2021

Submitted by

Vesna Zeljkovic, Ph.D.

Professor

Department of Chemistry and Physics

Lincoln University, PA 19352

BUDGET = \$5,000

Application date: 02/04/2021

1. A concise description of the project

Varicella, commonly known in the United States as chickenpox, is caused by the varicella-zoster virus. It represents a common childhood disease. It is an extremely contagious disease that is characterized by a blistering rash which manifests itself through various stages of appearance. It occurs most frequently in children, between the ages of five and eight. Somewhere less than 20 percent of all people affected by varicella in the U.S. are over 15 years old.

Varicella is generally regarded as a mild, self-limiting viral illness with occasional complications. It can also be very serious, especially in young infants and to a smaller degree in adults. Varicella is common and highly contagious. It affects nearly all susceptible children before adolescence. Chickenpox manifests itself through rash, itching, fever, and tiredness. The affected individual gets stomach, back and face covered with blister-like rash that often spreads over the entire body resulting in 250 or even 500 itchy blisters. Babies, adults, and people with weakened immune systems can be seriously affected by chickenpox. It can lead to severe skin infection, scars, pneumonia, encephalitis, brain damage, or even death.

Chickenpox is usually a nonthreatening disease in children, and almost all children recover uneventfully. However, varicella is not totally harmless even today. A significant number of varicella cases are associated with complications, among the most serious of which are varicella pneumonia and encephalitis. Occurring symptoms may include a history of low-grade fever, abdominal pain, a history of rash, intense pruritus, headache, malaise, anorexia, cough and coryza, and sore throat. Rash and fever are the typically observed during physical examination in pediatric patients with varicella. An ill appearance should raise concern for pulmonary or neurologic complications or serious bacterial superinfection. Adolescents, adults, and pregnant patients are at increased risk for more severe manifestations of this disease. Other groups that require specialized treatment are children who are immunocompromised, those who are otherwise at risk for severe disease, and those who already have more complicated medical history.

The chickenpox virus can be spread through the air, from one person to another, or by physical contact with chickenpox blisters' fluid. A person who has had chickenpox can get a painful rash called shingles years later.

In the United States, about 11,000 people were hospitalized for chickenpox each year and about 100 people died each year as a result of chickenpox before the varicella vaccine started to be applied in 1995. Also, until varicella vaccination became widespread in the United States, this disease affected approximately 4 million children per year, and was responsible for an estimated \$400 million in medical costs and lost wages each year. Still today worldwide it represents a serious problem especially in places where there are no vaccination programs.

The United States Food and Drug Administration approved a varicella-zoster virus vaccine for use in children to prevent chickenpox. This vaccine was tested in Japan, Korea, and the United States, and these extensive experimental investigations led to its final approval in the United States.

Although most varicella infections confer life-long immunity, varicella clinical reinfections among healthy children have been observed. Today, varicella vaccine can prevent this disease. Most people who get it will not get chickenpox. Since the varicella vaccine was introduced for children aged 12-18 months in the United States also in 1995 and booster vaccine is commonly given at age 4-5 years, disease incidence has substantially decreased. But if someone who has been vaccinated does get chickenpox, it is usually very mild. They will have fewer blisters, are less likely to have a fever, and will recover faster.

As a part of this project, we plan to develop a clinically applicable, a cost-effective algorithm for the automated autonomous varicella detection and test it on various images of individuals affected by this disease. We will design an image analysis tool capable to differentiate and detect varicella rash affected skin areas in the images taken under various environmental clinical conditions with the goal of assisting medical doctors in diagnostic procedures.

2. Measurable goals and objectives for the project

GOAL: Provide an automated approach to assisting medical doctors, general practitioners and dermatologists, in early varicella detection and its quantification.

OBJECTIVE: Design mathematical model and intelligent software capable of automatically detecting chickenpox incidence.

3. The timeframe for the project

Phase I:

June 2021 - July 2021 - Research collaboration with Prof. Dr. Christopher Druzgalski, Professor at the Electrical Engineering Department, California State University, Long Beach and Prof. Dr. Pedro Mayorga, Professor at the Instituto Tecnológico de Mexicali, Mexicali B.C., México. I will involve and train in the research two Lincoln students during summer and write a research paper on this topic that I intend to publish.

4. How the project will enhance teaching/learning at Lincoln University

This research will involve two Lincoln students and Engineering Science, Chemistry, Physics and Biology/PreMed major students from the Lincoln University can benefit from this research on whole as they will be exposed to the latest research achievements in this biomedical engineering interdisciplinary field. This will be very advantageous to them as minority students in STEM.

5. The number of people who will benefit, and how

About 5 students pursuing Engineering Science, Chemistry, Physics and Biology/PreMed majors from the Lincoln University will multiply benefit from this project as well as the colleagues from the Chemistry and Physics and Biology Department who will be involved in the research. The students will benefit through educational aspect, being directly involved in the research and by being exposed to other University's faculty members as well as graduate students.

6. How the success of the project will be measured

The success of the project will be measured multiply through:

- a) Successful presentation of the research results,
- b) Continued collaboration with the Electrical Engineering Department, California State University, Long Beach.
- c) Continued collaboration with the Instituto Tecnológico de Mexicali, Mexicali B.C., México.

7. How, when, where, and with whom the project's outcome will be shared

The research results will be presented and discussed in the Center for Excellence in Teaching and Learning, at the Chemistry and Physics Departmental meeting and the workshop will be organized for all the Lincoln University students and faculty members. A summary report of the project will be sent to the Chair of Faculty Development Committee.

Budget

The project budget is as follows:

TWO MONTH STIPEND 2 x \$2,500

TOTAL \$5,000