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DECLARATION

I declare that the dissertation hereby submitted to the University of Limpopo for the degree of Master of Science has not previously been submitted by me for the degree at this University or any other University, that is my own work in design and in execution, and that all material contained therein has been duly acknowledged.

Signed: _____

Date : _____

CERTIFICATION

I certify that this work was carried out by Kgasago Tshepo Matenatena Blessings under my supervision in the Applied Mathematics, University of Limpopo, Private bag X 1106 Sovenga 0727

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Supervisor

Professor O.D Makinde

DEDICATION

Firstly, to the ALMITY GOD, JESUS CHRIST AND THE HOLLY SPIRIT, OUR COMFOTER. To my Family, my Grandmother, Sherley Ramathabathe Mathabatha. My parents, Junious Mahlahle and Maggy Raesetja Kgasago. My Sisters, Thelma, Bernice and Leaflet. My Brothers, Jack Moketse, Lerato Knowledge and Karabo. Not forgetting Mahlogonolo, Mororiseng and lastly Bless 'T' Junior. Thank you for the support you have given me. In the Holly name of our Comfoter we shall prosper.

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Abstract

In this dissertation, two non-linear mathematical models are proposed and analyzed to investigate the spread of infectious diseases in a variable size population through horizontal transmission in the presence of preventive or therapeutic vaccines which are capable of inducing temporary immunity and wane in time. In modeling the transmission dynamics, the population is divided into three subclasses namely; Susceptibles, Infectives and Vaccinated groups. It is assumed that both Vaccinated and Susceptible individuals are recruited into the community and can only become infected via contacts with the infectives group but the rate at which the vaccinated group may contract the diseases is extremely very low depending on the efficacy of the vaccine. All infectives are assumed to move at a constant rate to both Vaccinated and Susceptible groups.

These models are analyzed by using the stability theory of differential equations and numerical simulation. The models exhibit two equilibria namely; the disease-free and the endemic equilibria. It is shown that if the vaccination reproduction number $R_0 < 1$, the disease-free equilibrium is always globally asymptotically stable and in such a case the endemic equilibrium does not exist and the disease can be totally eliminated in the community. However, if $R_0 > 1$, a unique endemic equilibrium exists that is locally asymptotically stable and consequently the equilibrium values of infective, vaccinated and susceptible population can be maintained at desired levels. Numerical simulations implemented on MAPLE using both Adomian decomposition technique and Runge-Kutta integration schemes, support our analytical conclusions and illustrate possible behaviour scenarios of the models.

In Chapter one, a review of the background study on the infectious diseases transmission models together relevant literatures are presented. A mathematical model on the transmission dynamics of infectious diseases in the presence of vaccine induced temporary immunity is proposed, analysed and discussed in Chapter two. In Chapter three, the combined effects of an ineffective vaccine and its temporarily induced immunity on the transmission is been studied.