Roads to health

multi-state modelling of population health and resource use
Cover illustration
Title: “Abode hut and main frame computer”; pencil drawing by author, age 15. The left two-thirds of the drawing depicts the developing world; the right side represents the developed world.

Editing contributions
Ken Redekop and Hilde van Meer.

Funding
The research reported in the book was carried out at the Dutch National Institute of Public and Environment (RIVM) and at the Institutes of Public Health and for Medical Technology Assessment, Erasmus University. The United Nations Environmental Programme (UNEP), the Dutch Ministry of Health and the World Health Organisation (WHO) provided funding. The Population Research Centre, University of Groningen made this publication possible.

© Louis Niessen, 2002, Rotterdam; nissen@bmg.eur.nl.

All rights reserved. Save exceptions stated by the law, no part of this publication may be reproduced, stored in a retrieval system of any nature, or transmitted in any form or by any means electronic, mechanical, photocopying, recording or otherwise, included a complete or partial transcription, without the prior written permission the publisher, application for which should be addressed to the publisher: Rozenberg Publishers/Dutch University Press, Amsterdam, The Netherlands. Tel. +31 ((0) 20 625 54 29; Fax: +31 (0) 20 620 33 95; E-mail: info@dup.nl.
Roads to health

multi-state modelling of population health and resource use

Proefschrift

ter verkrijging van het doctoraat
in de Ruimtelijke Wetenschappen
aan de Rijksuniversiteit Groningen
op gezag van de
Rector Magnificus, dr F Zwarts,
in het openbaar te verdedigen op
donderdag 5 december 2002
om 14.15 uur
door

Louis Wilhelmus Niessen

geboren op 8 december 1952
te Den Haag
Promotores

Prof dr ir FJ Willekens
Prof dr FFH Rutten

Beoordelingscommissie

Prof dr J van der Gaag
Prof dr J Kievit
Prof dr LJG van Wissen
“I got the clouds but not the sky“
Tom Waits: ‘Big in Japan’, Mule Variations

To: Hanne, Tjjs, and Marre
Details doctorate committee

Promotors
Prof dr ir FJ Willekens,
Population Research Centre, Faculty Spatial Sciences,
University of Groningen
Prof dr FFH Rutten,
Institutes Health Policy & Management and Medical Technology Assessment,
Erasmus University Rotterdam

Other members
Prof dr J van der Gaag,
Department of Economics & Econometrics, University of Amsterdam
Prof dr J Kievit,
Department of Medical Decision Making, University of Leiden,
Prof dr LJG van Wissen,
Population Research Centre, Faculty of Spatial Sciences
University of Groningen

Opponent members
Dr JJ Barendregt,
Department of Public Health, Erasmus University Rotterdam
Dr D Bishai,
Department Population & Family Health, Johns Hopkins University
Prof dr J van Dijk,
Faculty of Spatial Sciences, University of Groningen
# TABLE OF CONTENTS

## PREFACE

## PART I: INTRODUCTION

1. The lifetime approach to population health modelling
   - 1.1. Summary
   - 1.2. Approaches in integrated modelling
   - 1.3. A typology of multi-state modelling in uncertainty
     - 1.3.1. From causal framework to multi-state model
     - 1.3.2. A modelling framework for population health
     - 1.3.3. Model inputs: value distributions for states and flows
   - 1.3.4. Model outcomes: lifetime health and medical costs
     - 1.3.4.1. Changing health
     - 1.3.4.2. Changing medical costs
     - 1.3.4.3. Changing health and costs: cost-effectiveness
   - 1.4. General research questions and book outline

## PART II: THE DYNAMICS OF DISEASE OCCURRENCE

2. Health determinants and disease occurrence
   - 2.1. Summary
   - 2.2. Health transitions
   - 2.3. Population health issues by transition stage
     - 2.3.1. High mortality stage
     - 2.3.2. Declining mortality stage
     - 2.3.3. Low mortality stage
   - 2.4. General research postulate: multiple roads to health

3. Multi-state modelling of disease occurrence
   - 3.1. Summary
   - 3.2. A generic approach to health modelling
   - 3.3. Multiple health determinants
   - 3.4. Multiple diseases
   - 3.5. Model implementation and validation
     - 3.5.1. Definitions of validation
     - 3.5.2. Validation of the generic framework
   - 3.6. Conclusion

## PART III: MULTI-STATE MODELLING

4. Determinants of mortality decline
   - 4.1. Summary
   - 4.2. Introduction
   - 4.3. Scenario methodology
   - 4.4. Scenarios for India, Mexico and The Netherlands
PREFACE

My initiation into health research took place when I entered Erasmus medical school. I had been attracted by it’s ‘Querido concept’ aiming for a synthesis of scientific insights and medical practice. This resulted in a first publication in neuroscience. As a graduate, I struggled with Tanahasi’s papers on the assessment of health services and on health & development. This book, my doctorate thesis, is a milestone on the same road.

I thank Frans Willekens and Frans Rutten for trust, opportunity, and guidance. As their disciplines are completely interwoven in this thesis, I wish that Dutch universities would facilitate joint doctorates. Frans W, introducing the topic, I proposed to finish in three years. The inspirational sessions with you and your group made me finish in due time i.e. twice as long as planned. Your methodological and international experience contributed essentials. Frans R, without knowing we have been on the same road: you started MTA at Erasmus when I studied health economics at LSE. I thank you also for the chance to expand its horizons. I thank the committee members for reading the manuscript. Amidst studies and projects, I met special people contributing to my rebirth from a young, angry clinician into a thoughtful researcher. Hans Valkenburg at medical school shared the orientation on both developing and developed countries. As an enlightened epidemiologist, he was the first to point out to me the potential of health modelling. Brian Abel-Smith and George Cumper in London showed me how health economics blends with public health. Jan Barendregt and Luc Bonneux at Erasmus are kindred souls. Bert de Vries and Rudolf Hoogenveen at the National Institute made me keep my sense of direction. Ben van Hout at Erasmus had answers to my questioning, leaving room for my own. I thank these ‘maestros’ for sharing their insights, each in a unique way. This research becomes fiction without inputs from the real clinical world. In order of appearance, I thank Peter Koudstaal, Diederik Dippel, Martin Limburg, Cees Franke, Richard Eastman, Ton Casparie, Evert van Ballegooie, Henk Bilo, Bettina Polak, Karel Bakker, and Guy Rutten for contributing to the formulation of clinical questions and models. I thank the master students under my guidance for their contributions: Chiafen Hsu, Nicole van Os, Kyra Edelenbos, Aziza Mwisongo, Rudolf Schrover, Rimma Shaginian and Leontien Laterveer. Rob Dijkstra in Nijmegen and Raymond Hutubessy in Geneva contributed also to chapters.

My neglected friends, I am back again from an interesting trip. My biggest smile is for my deceased parents. They are watching me from somewhere inside of me, proud in their own way. Willem, brother, I am happy you can share this book with me. Silvia, inspiring for decades, I dedicate the Mexico study to you. Hanne, Tijs, and Marre, my dearest, may you always be there like you have been during my writing. Hilde, the last words are for you: “Jungle deep, mountain high!”

Mijn verwaarloosde vrienden, ik ben weer terug van een interessante reis. Mijn grootste glimlach is voor mijn overleden ouders. Van ergens in mij zijn ze me blijven observeren, trots, op hun eigen manier. Willem, broer, ik ben blij dat ik dit boek met je kan delen. Silvia, inspirerend door de jaren heen, ik draag de Mexico studie aan jou op. Hanne, Tijs en Marre, mijn allerliefsten, mogen jullie er altijd zijn, net zoals jullie tijdens het schrijven er altijd geweest zijn. Hilde, de laatste woorden zijn voor jou: “Jungle deep, mountain high!”

Rotterdam, June 2002