Preface

In health care systems that provide universal access to care, efforts to contain costs for standby hospital capacity usually result in wait lists for surgical procedures. When access to health care is rationed by such wait lists, the length of time that patients are required to wait is usually uncertain. This uncertainty is a natural product of stochastic variation in service time and in the percentage of urgent cases in any queuing system. However, in a queue for elective (nonemergency) procedures, waiting-time uncertainty has many additional causes. For instance, decisions of both patients and care providers may override a queue discipline. Alternatively, the lack of a hospital resource, such as beds in the intensive care unit, may change queuing practices in favor of services that would not require the resource.

Waiting time is often compared between regions, hospitals, periods, or surgical services to evaluate policy and performance. However, surprisingly little attention has been given to the variation in times spent in a single queue. Why some patients wait longer than others remains an important question in health services research. It is unclear, for example, whether time to service varies more than would be expected through chance alone after differences in clinical condition are taken into account. Another important issue is preferential allocation of hospital resources. It also remains unclear whether patients of low priority are admitted directly as a way to circumvent long wait lists or to substitute for cancellations on the operating room schedule. Wait lists for elective surgery have typically been accepted on the premise that they ensure the most efficient use of hospital resources; the only alternative would be underutilization of capacity within the health care system. Recently, however, the debate has shifted toward the issue of how much capacity is required to maintain safe wait lists. Policy makers have called for establishing target access times for major operations that would minimize the adverse events associated with treatment delay.

Although it was recognized early that methods of time-to-event analysis are applicable to waiting-time data, literature on the methodology of collecting, reporting, and analyzing waiting times is scarce, in particular for applications of competing-risks methods. The purpose of this book is to place the analysis of waiting-time data within the paradigm of health services research, the study of outcomes of health care delivery to a population. We suggest two uses for this book. First, it is intended as a reference for health services researchers who are looking for statistical tools with which to study waiting times for health services. The book provides coverage of statistical concepts and methods for the analysis and interpretation of waiting-time data, such as time-to-event analysis, discrete-time regression models, competing risks, and pseudovalues regression models. Second, the book is a workbook for a range of professionals in the healthcare community, offering a collection of examples of waiting-time data analysis in health services research. It gives a practical perspective, from framing the study question through interpretation of results, on how to

describe and compare waiting experiences, how to study the impact of factors associated with waiting times, and how to use appropriate statistical techniques.

The book is divided into 10 chapters, grouped in two parts. Part I, Data, Questions and Methods, introduces the field of health services research on access to care. Chapter 1 provides a comprehensive overview of waiting-time data in health services research. In particular, we describe types of data and types of questions, study designs, and options for analysis of waiting-time data. We then develop the statistical rationale for evaluating the effects of factors potentially associated with waiting times in surgical care by defining a study outcome admission from the wait list. Arguing that scheduling the operation provides a single opportunity for admission, we develop a measure of access to elective procedures the probability of admission per scheduling cycle. We observe that because factors interfering with access may lower chances of admission, it is possible to study their impact on access to service by estimating the probability of admission across categories of explanatory variables. The effects of study variables can be further estimated by modeling the probability of admission as a function of study variables. In Chapter 2, we described three sets of records on access to surgery at the hospital, regional, and population level, respectively, which are used for the analyses in Part II. Chapter 3 presents statistical methods for the analysis of waiting-time data. We first introduce the descriptive statistics that are used to summarize the frequency of events on wait lists, such as proportions, event rates, and cumulative incidence functions. In particular, we show that measuring the proportion of patients admitted within certain time frames may shed light on how factors within and outside elective care influence the probability of access to service. We then discuss measures of comparison and introduce corresponding tests for comparing these measures statistically across groups. Finally, we describe regression models that are used to quantify the effects of explanatory variables on wait-list outcomes. For each model we show how to interpret the regression coefficients.

Part II, Waiting-time Studies, presents case studies of waiting-time data, in which we address the questions posed in Part I. In particular, in Chapter 3 we show the use of waiting-time data to estimate admission probabilities and to study variation in waiting times within a single queue. In the chapters that follow, we show statistical techniques appropriate for gaining a better understanding of the relation between weekly number of emergency referrals and rate of elective admissions within the target access time, the proportion of patients who undergo late surgery after registration on surgical wait lists of different sizes, the effect of delays in scheduling an operation on waiting time for surgery, and the risk of unplanned emergency surgery among patients waiting for elective surgery, among other issues.

The data analyses and output presented in this book were generated using SAS/STAT software from the SAS System for Windows, version 9.1.3. Matlab version 7.0.1 from MathWorks, Inc. was used to generate the figures presented in this book and perform some statistical analyses. The appendix contains the SAS codes and macros that we developed for preparing the data sets described in Part I, as well as the SAS and Matlab codes for performing some of the statistical analyses in Part II.

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Innovations in health care management require leadership. We dedicate this book to Dr. Peter Brown, a valued leader who championed the Change Foundation Waiting List Project that gave birth to wait-list management systems in the network of regional hospitals in Ontario, Canada.

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