Chapter 8
Strategic Analytics to Drive Provincial Dialysis Capacity Planning:
The Case of Ontario Renal Network

Neal Kaw
University of Toronto, Canada

Somayeh Sadat
Tarbiat Modares University, Iran

Ali Vahit Esensoy
Cancer Care Ontario, Canada

Zhihui (Amy) Liu
Cancer Care Ontario, Canada

Sarah Jane Bastedo
Ontario Renal Network, Canada

Gihad Nesrallah
St. Michael's Hospital, Canada

ABSTRACT

This chapter discusses applications of analytics at the strategic level of health system planning in the province of Ontario, Canada. To supplement the strategic priorities of the Ontario Renal Plan I, a roadmap developed by the Ontario Renal Network to guide its directions in coordinating renal care province-wide, an interactive user-friendly analytical capacity planning model was developed to forecast the growth of the prevalent chronic dialysis patient population and estimate consequent future need for hemodialysis stations at Ontario's dialysis facilities. The model also projects operational funding to care for dialysis patients, vascular surgeries to achieve arteriovenous fistula targets, peritoneal dialysis catheter insertions to achieve peritoneal dialysis prevalence targets, and incident dialysis patients to be sent home to achieve prevalent home dialysis targets. The model uses a variety of analytical methods, including time series analysis, mathematical optimization, geo-spatial analysis and Monte Carlo simulation.

INTRODUCTION

Chronic Kidney Disease (CKD)

A diagnosis of CKD generally means that the kidneys have not been working properly in eliminating wastes and excess fluids from the body for at least 3 months. CKD is divided into five stages that depend on severity. If detected in early stages of the disease, it may be possible to slow the progression of kidney failure through lifestyle changes and medication. Once the kidneys fail (in stage 5 of CKD, which is also known as End-Stage-Renal-Disease or ESRD), patients may receive renal replacement therapies (dialysis or transplant) or opt for palliative care. A transplanted kidney may fail at any point and the patient be put on dialysis or opt to receive palliative care. While it is ideal to detect CKD as early as possible, the disease may go undetected up to the point when the patient needs dialysis. In fact, such "crash start" patients comprised about a quarter of new dialysis patients in Ontario in 2014 (Ontario Renal Network, 2015).

There are two main dialysis modalities: hemodialysis and peritoneal dialysis. Hemodialysis draws the patient's blood through a filter to remove waste products and excess water, and normalize blood chemistry. Hemodialysis requires a vascular access. Arteriovenous (AV) fistula and the AV grafts are vascular access designed for long-term use, with AV fistula deemed to be the superior vascular access type. Both AV fistulae and AV grafts are established by surgical procedures. However, these procedures are technically challenging, and many patients have suboptimal anatomy that precludes successful fistula or graft creation. Consequently, while AV access are associated with better patient outcomes, many patients require a central venous catheter for long-term hemodialysis access. Peritoneal dialysis utilizes the peritoneum, a membrane that lines the abdominal cavity as the filter and a catheter implanted in the abdominal wall to instill and withdraw dialysis fluid.

Hemodialysis patients may receive dialysis care in a facility or at home, while peritoneal dialysis is generally performed at home. In-facility patients generally receive dialysis 3-5 times per week, while home dialysis patients are able to dialyze more frequently. Patients receiving home hemodialysis often dialyze overnight (nocturnal hemodialysis) to maximize hours of treatment while minimizing the number of daytime hours impacted by the therapy. From time to time, home dialysis patients may temporarily require care at a hub facility due to complications or the need for more intensive care. Such instances are called "fall backs".

A simplified CKD disease progression pathway is shown in Figure 1. At each transition point, a minority of patients progress to the next state. Other potential states include death, relocation, and non-dialytic management of kidney failure (conservative care with palliation).

CKD Worldwide

CKD is a growing problem worldwide, with an estimated prevalence of 200 million people worldwide and a growing burden especially in low to middle income countries undergoing epidemiologic transition towards non-communicable chronic diseases (Ojo, 2014). Other studies have estimated the prevalence of CKD to be around 8-16% (Jha et al., 2013) and 13.4% (Hill et al., 2016). The 2015 Global Burden of Disease study found all-age Disability-Adjusted-Life-Years or DALYs (in thousands) of 35259.7 (up from 29488.3 in 2005) or in other words 19.6 percentage of change between 2005 and 2015, moving up from the 22nd leading cause of global DALYs for both sexes in 2005 to the 20th (Kassebaum et al., 2016).

Related Content

Cooperative Decision Support Systems
Pascale Zaraté (2008). *Encyclopedia of Decision Making and Decision Support Technologies (pp. 109-115).*
www.irma-international.org/chapter/cooperative-decision-support-systems/11246

Development of System Typology and Choice of Preferred Simulation Modelling Methods for DSS-Toolkit
Oleg Nikolaevich Dmitriev (2022). *International Journal of Decision Support System Technology (pp. 1-25).*
www.irma-international.org/article/development-of-system-typology-and-choice-of-preferred-simulation-modelling-methods-for-dss-toolkit/286679

Decision Support for Crisis Incidents
Daniel J. Power, Roberta M. Rothand Rex Karsten (2011). *International Journal of Decision Support System Technology (pp. 44-56).*
www.irma-international.org/article/decision-support-crisis-incidents/53815

Transformation Mechanisms in the Business Model/Business Process Interface
Tobias Weiblen, Markus Schiefand Amir Bonakdar (2017). *Decision Management: Concepts, Methodologies, Tools, and Applications (pp. 878-901).*
www.irma-international.org/chapter/transformation-mechanisms-in-the-business-modelbusiness-process-interface/176784

Representative Case-Based Retrieval to Support Case-Based Reasoning for Prediction
Abdelhak Mansouland Baghdad Atmani (2021). *International Journal of Strategic Decision Sciences (pp. 14-35).*
www.irma-international.org/article/representative-case-based-retrieval-support/298591